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Uncertainty and Human Capital Decisions: Traditional Valuation Methods and Real Options Logic

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As the importance of human capital increases in organizations, so does the need to develop more sophisticated financial valuation models. This paper reviews some of the major traditional financial decision making models used in costing employment mode choices. It then introduces the real options valuation approach for costing such choices. The advantage of the real options model is demonstrated to build flexibility into employment decisions.

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Abstract

As the importance of human capital increases in organizations, so does the need to develop more sophisticated financial valuation models. This paper reviews some of the major traditional financial decision making models used in costing employment mode choices. It then introduces the real options valuation approach for costing such choices. The advantage of the real options model is demonstrated to build flexibility into employment decisions.

Uncertainty and Human Capital Decisions: Traditional Valuation Methods and Real Options Logic

"*The breakneck pace of change and elevated uncertainty demand new ways of strategic thinking and new tools for financial analysis*."[1]

Consider the following example:

You are the HR Director of an IT design service provider who has the opportunity to sign a one-year, renewable contract. Under the terms of the agreement, your services would be extended into years two and three contingent upon satisfactory performance in year one. You will receive payment of $45 million in year one, with the opportunity to negotiate up to a 5 percent increase in years two and three dependent upon appropriate productivity increases. In order to service this contract, you will need 400 additional full-time employees. Each of these employees would incur $40,000 in initial hiring, relocation, training and development costs. Per-employee wage and benefits costs are $100,000 annually. You are excited about the contract, but unfortunately the timing is not optimal. You know the cost to hire 400 employees may negate any potential benefits. Furthermore, in one year's time, you will have 400 similarly skilled employees coming off an expiring contract who will either need to be re-deployed elsewhere or terminated.

Considering the New World for Decision Making

This scenario illustrates the fact that the current business environment is marked by heightened uncertainty, increased cost pressures, and expanding global competition. These factors have led to the utilization of various alternative work arrangements. Companies have created blended workforces consisting of core and flexible employees in order to control costs, mitigate risks, and create flexibility. Other companies are pursuing offshoring and outsourcing strategies to control the costs of labor's salary and benefits.

Despite the financial benefits of a variable, offshore or outsourced workforce, labor costs continue to be the greatest expenditure that companies incur. In response, human capital is increasingly being viewed as a critical economic resource, or asset. While firms increasingly

[1] Mauboussin, M.J. (1999). Get real: Using real options in security analysis. *Frontiers of Finance: Credit Suisse First Boston Corporation, Equity Research,* Vol. 10.

refer to their workforce as “our most important asset,” as with a traditional capital investment, human capital assets may provide competitive advantage and value, but also carry with them certain uncertainties and risks (Bhattacharya & Wright, 2005). Thus, these assets can be considered within the framework of current and future “investments.”

Decisions regarding where and how to invest in human capital are becoming more difficult. Trade-offs exist with any option. A firm might choose to invest in a temporary or contract labor force to increase their flexibility. However, there are uncertainties and risks associated with productivity. A firm might choose to engage in an outsourcing strategy, but there are risk and uncertainties with quality of work. Finally, a firm might choose to offshore work and there are risks and uncertainties regarding quality and salary.

Traditional HRM tools are not appropriate to value decisions and returns in today’s dynamic business environment. HRM needs to extend beyond metrics and engage with the finance function to shift their valuation techniques for application to HRM decisions regarding human capital. In response to this need, the following paper will review the financial valuation methods, tools and approaches that can be used to determine the value of an investment in human capital while analyzing the risk that impacts the decision making process.

HR, particularly employment model, decisions do not exist in a vacuum. Because labor (wages/salary and benefits) constitutes one of a firm’s largest costs, employment levels (number of employees) and models (FTE vs. contingent/contract) have become critical variables in strategic decision making. However, considering total employment costs with regard to strategic decisions such as growth, offshoring, outsourcing, or acquisitions requires sophisticated considerations of both how those costs will change over time and under conditions of uncertainty.

Costing Methods & Decision Making Tools

Several approaches are used in business to assess cost versus benefits, the time value of money, and the overall value of a choice over time. This valuation process considers how an

asset may provide the capability of generating extrinsic monetary value or intrinsic strategic value. Traditional valuation methods include net present value, scenario analysis and sensitivity analysis. These methods have been applied by a number of HR organizations in making employment decisions historically. However, in complement to the traditional cash flow approaches, there are emerging new analytical approaches to identify the value of an investment in light of a dynamic environment. These include Monte Carlo analysis and Real Options logic. We will explore each of these methods, particularly though showing how each method might be used to answer the case presented at the beginning of this paper. Comparing and contrasting the different conclusions offered by the different techniques helps to highlight the complexity facing HR organizations today.

Traditional Tools

Net Present Value (NPV): The NPV model of evaluating an investment calculates the present value of expected project benefits minus the present value of expected project costs. A discounted rate of interest based on the marginal cost of capital to future cash flows is used to bring the costs and benefits into to the present. Generally the weighted average cost of capital (WACC) for an organization is used as the discount rate. Projects with a positive NPV are expected to increase the value of the firm. Thus, the NPV decision rule specifies that all independent projects with a positive NPV should be accepted. When choosing among mutually exclusive projects, the project with the largest (positive) NPV should be selected.

This method of analysis benefits from its simplicity and is widely understood. However, the analysis is based on cost and benefit expectations generated using educated guesswork. For projects with high risk and little past experience, the analysis is limited by the users' ability to accurately predict future cash flows. Moreover, the NPV analysis does not adequately take into consideration unforeseen impacts to cash flow in the future.

To apply NPV analysis to the above example, first, you assess the potential net present value of the project based on known costs and revenues. Using data from past projects, you

know your company's weighted average cost of capital (WACC) runs around 10 percent. The negative $16 million in time zero reflects the costs of hiring, training and relocating employees. The discounted cash flows in times one, two and three reflect the NPV calculations of the project. The traditional NPV decision rule is to reject any project if the calculation comes out with a negative value. Because the NPV approach shows a negative $3 million for the project, based on this analysis alone, the project should be rejected.

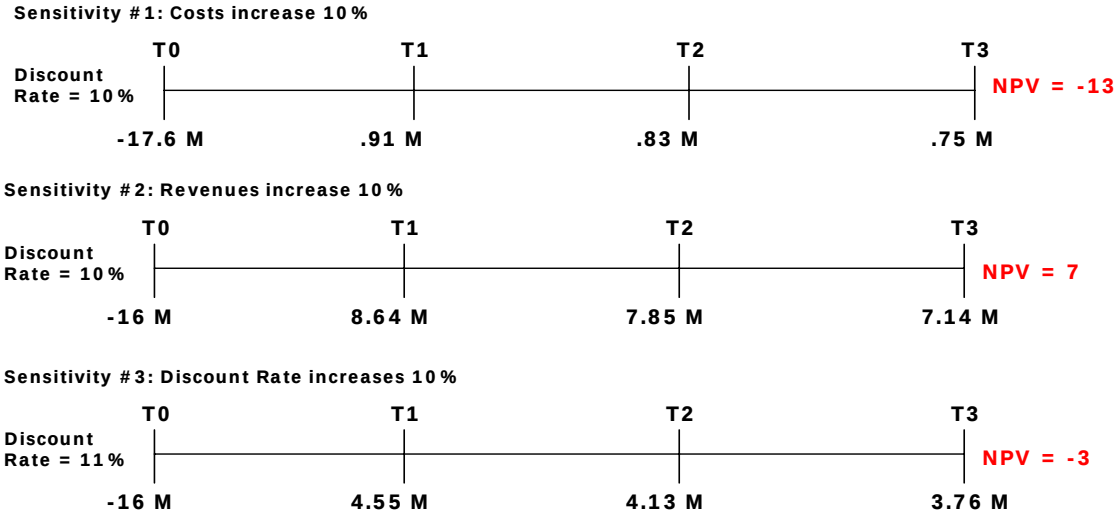
Decision Rule: NPV < 0 = Reject Contract

Decision = Reject Contract

Sensitivity Analysis: One method to make the NPV more dynamic is to calculate a sensitivity analysis. Also known as the *variable-by variable* or *what-if* approach, it determines the impact of changing one or several variables in a model or analysis on the outcome of the analysis. A sensitivity analysis allows a range of inputs to be considered when there is uncertainty about the true value of an input. Examples include comparing results using a discount rate of 3% with result using rates of 5% and 10% or observing the changes if expenses rise 5% or income drops 10%. The resulting NPV's should be examined to determine the degree of overall variation and which factor or factors is/are most responsible for variation in the estimates. Using sensitivity analysis, each of the inputs to the NPV calculation is systematically changed by the same percent. The NPV is most sensitive to the factor with the greatest difference between the NPV and the base-line NPV. This shows the user if and where leverage points exist to alter the return on a project.

Therefore, the second step in the analysis is to complete a sensitivity analysis. In the sensitivity analysis, each factor in the NPV calculation is increased by 10 percent to show the

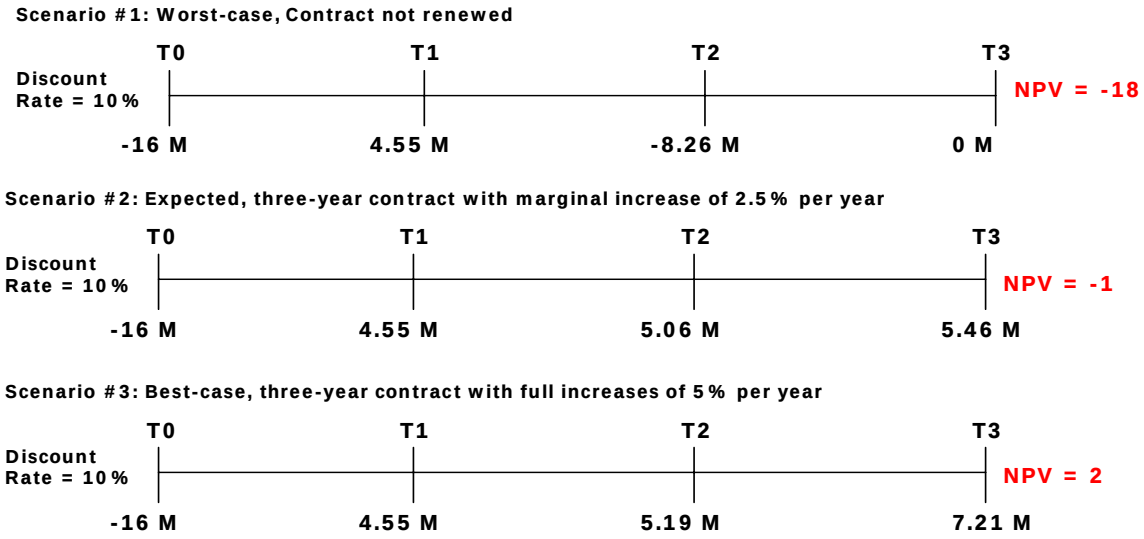
relative influence on the baseline NPV calculation. This returns the priority by which risk factors should be considered. For example, this analysis shows that changes to cost and benefits have the most influence on the NPV calculation. However, you know there is very little potential for the benefits from the project to change substantially. Therefore, in order to influence the NPV, you will have to find ways to reduce the project costs to result in a positive NPV.



Scenario Analysis: Scenario analysis is a process of analyzing possible future events by considering alternative possible outcomes (scenarios). The scenarios most often used show the projected NPV are the best-case, worst-case and expected-case scenarios. This variation affords the decision maker a broader picture of the possible outcomes and their implications. Scenario analysis is based on the assumption that factors affecting cost-benefit flows do not operate independently of one another as is assumed in a sensitivity analysis. This is helpful in that it describes project extremes, but again, only to the extent that those are identified. It can also help to identify the level of risk an organization is comfortable with because it determines the most that can be lost or the most gained from a project.

The project did not look promising using NPV, what happens to the analysis with a best-case, expected case and worst-case scenario. Analyzing the best, worst and expected case allows you to assess the level of risk you are willing to undertake associated with the project. In

this situation the worst case scenario is the contract is not renewed in year two and you are saddled with 400 employees who need to be redeployed or terminated. In this situation, it is modeled that those individuals are terminated and the company must pay severance costs, which are reflected in time two. In the expected case scenario, the contract is renewed all three years, but you only are able to negotiate a 2.5 percent per year change in benefits. This does not return a positive NPV. Finally, the best case scenario is that the contract is renewed for three years and you are able to negotiate a five percent per year increase in benefits. In this situation you attain a positive NPV.



So scenario analysis allows HR decision makers to make assumptions about potential alternative outcomes, explore the expected NPV's under each of those outcomes, and then make a decision based on a broad assessment of risk and opportunity.

Discussion

There are several advantages to the traditional tools. Each of these tools is quantitatively based and factors in the time value of money, which are important considerations when making investment decisions. Using these tools over time provides consistent decision criteria and offers the same results regardless of the risk preferences of investors. Moreover, these tools are widely taught and widely used so their acceptance and the understanding of such tools within

the business community are widespread. Finally, the results from the tools are simple to explain to business leaders. If benefits outweigh costs, you should go forward with the project.

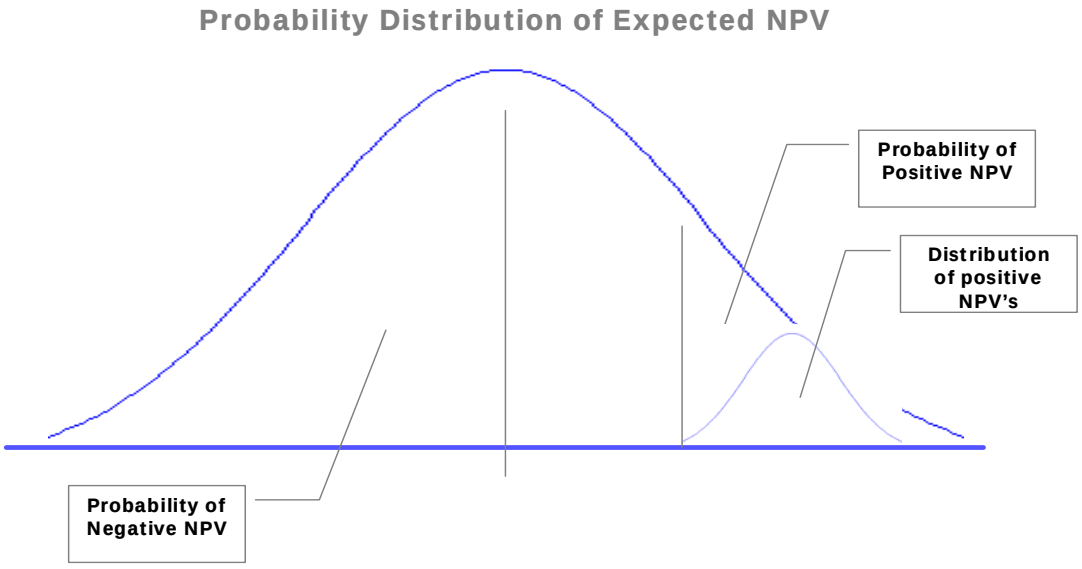
However, several disadvantages emerge from the static nature of the tools. The analysis of the tools is only as good as the estimate of future cash flows. If estimates are exact, the analysis is excellent. If estimates are unknown or uncertain the analysis is limited. In this manner, traditional valuation tools do not factor in the value or the risk associated with uncertainty in the future. Additionally, they are inherently limited in valuing flexibility in decision making. For these reasons there is the potential to either overvalue or underestimate the value of a project.

New Analytic Tools

Monte Carlo Analysis: A Monte Carlo analysis randomly generates values for uncertain variables over and over to simulate a model. This is done through a computerized technique which replicates real life occurrences by mathematically modeling a projected event. It is an advanced and much less burdensome form of scenario analysis. However, unlike scenario analysis that aggregates across all relevant variables to describe a few finite and discrete scenarios, Monte Carlo analysis allows decision makers to simultaneously consider a multitude of variables (e.g., sales changes, wage rate changes, changes in the weighted cost of capital, etc.), each of which may take on an unlimited number of values, and describe the probabilities of certain outcomes. Monte Carlo analysis is performed by setting boundary assumptions and a range of boundary values for a variety of variables relevant to the decision based on past experience. The results are probabilistic (they form a probability distribution) and therefore yield an expected value (mean) and a standard deviation, as well as cumulative probabilities (zero to 100 percent) which express total likelihood (probability) of a variable outcome. A computer program will then run millions of scenarios and return the probability a modeled event (e.g., an NPV greater than 0) will occur. A disadvantage of the analysis is that

the probability is only as good as the assumptions set. Regardless, Monte Carlo analysis can be very helpful in providing a clearer picture of risks associated with a project.

Returning to the example, the using the current parameters and methods the project doesn't look like it will be viable. However, you can run an analysis using Monte Carlo simulations to see exactly what the probability is the best-case predicted scenario will occur, as that had a positive NPV. It enables you to define assumptions, forecasts and run preferences for a project. It will then return the probability of an event occurring. For this example, you would analyze the probability of the project returning a positive NPV over time. The figure below describes the output of the Monte Carlo analysis. After the assumptions, forecasts and preferences are set, you are able to run the simulation. Monte Carlo will run as many trials, using a random number generator, as was requested and saves the forecast values (Goldman, 2002). Forecast values take the form of a probability like that displayed below. The Monte Carlo analysis will return a probability distribution of the expected NPV. Within that, you will be able to see the probability of a positive NPV. Within the positive NPV area it is possible to see the range of potential expected outcomes.



While not describing real values, the diagram above illustrates a normal probability distribution. A Monte Carlo program might reveal that, given the assumptions you made regarding all of the relevant variables, across the thousands of different scenarios it calculated values for, a positive NPV resulted 13% of the time.

Real Options Theory

An emerging process in the valuation of human capital is the risk analysis technique of real options. It is a technique, which looks at strategic decisions in terms of the options they create and values these options. It implies that there are ways to hedge against risk and to reduce uncertainty. Essentially, a real option is the right, but not the obligation, to undertake some business decision or investment.

Real options theory has its basis in financial options. Financial options focus on ways of managing risk in the purchase of financial securities (such as stocks) under conditions of uncertainty. Financial options entail paying a premium in order to not have to make the full investment until more information is available. Option contracts provide the buyer the rights to future ownership of the underlying asset at an agreed price, without being obliged to invest. A premium, usually less than the price of the underlying asset, is charged for the option contracts. The option's ultimate value can be said to depend on, and derive from that of the underlying asset. The price of the option depends on the volatility of the underlying stock, greater volatility of the price of underlying asset leads to increased value of the option because of greater potential gains.

'Calls' (options to buy), and 'puts' (options to sell) are the contracts mostly used in the financial options market. Call options are contracts written on a stock at a premium, giving the owner the right, but not the obligation, to buy the stock at a predetermined strike price within a future expiration date. Put options are contracts to sell (i.e. they give the owner the right, but not the obligation, to sell) the stock at a strike price within the expiration date. Financial investment

managers often maintain a combination of these two types of contracts in order to guarantee returns from financial investments.

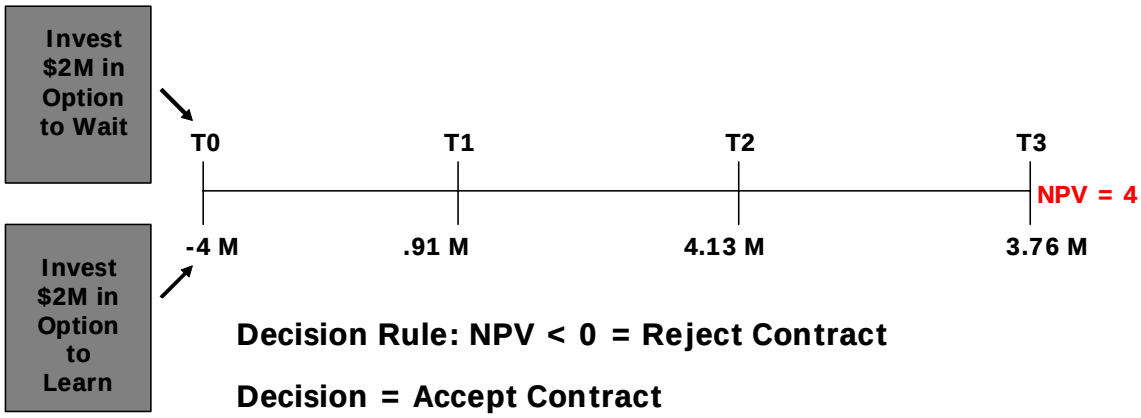
Real options extends this logic to decisions about investments in real assets such as plants, property, or equipment, under conditions of uncertainty. Real options theory scholars seek to understand decisions regarding investments in real assets that are similar to financial options in structure but for which the assumptions made in valuing financial options do not hold (Bowman & Hurry, 1993; Dixit & Pindyck, 1994). The real options theory has been applied to the decision-making process for investments in real assets like new technology, new collaborations, new venture creation, new projects etc. (Kogut & Kulatilaka, 1994). The primary assertion of this theory is that real options create alternative choices for decisions regarding investments in real assets, at a lower cost, for an organization. These choices are time deferred so the organization is able to base its decisions on actual circumstances that may occur in the future, rather than on the expectation (or inaccurate approximation) of the future. Since the future is uncertain, these deferred choices greatly reduce the risk that investments will lose their entire value or will become worthless. Real options give the owner the rights to real assets without making the full investment in the present time period, and to keep the opportunities for future investments open.

A growing body of researchers and practitioners are applying real options as a viable alternative to human asset decisions (Bhattacharya & Wright, 2005). Applied to HRM, firms may face uncertainties associated with volume and mix or ability to deploy human capital. Uncertainties of returns from human capital stem from the interface of the supply of the labor market with the demand of the firm. For instance, environmental forces like fast changes in business conditions, greater complexity in business, rapid internationalization, changes in technology, new competition, or innovation impact the skill demand of firms through requiring different skills of employees (rapid learning, global perspectives, creativity, etc.) which give rise to uncertainties of return. In other words, the value of skills may change from one time period to

another. Uncertainties of volume arise due to fluctuations of demand and supply of the number of employees. In other words, economic slowdowns or seasonal demand patterns can creat uncertainty with regard to the numbers of employees needed. Uncertainties of combination arise when there is a need for reallocation of employees or their skills within the firm due to qualitative/quantitative variations in demand and supply.

These uncertainties make it difficult to effectively determine the costs and returns from human capital decisions. To hedge against those uncertainties, a firm could purchase timing options (hiring contingent, part-time or temporary employees) or switching options (using job rotation or team-based work), which is the basic logic behind applying real options thinking to human capital decision making (Bhattacharya & Wright, 2005).

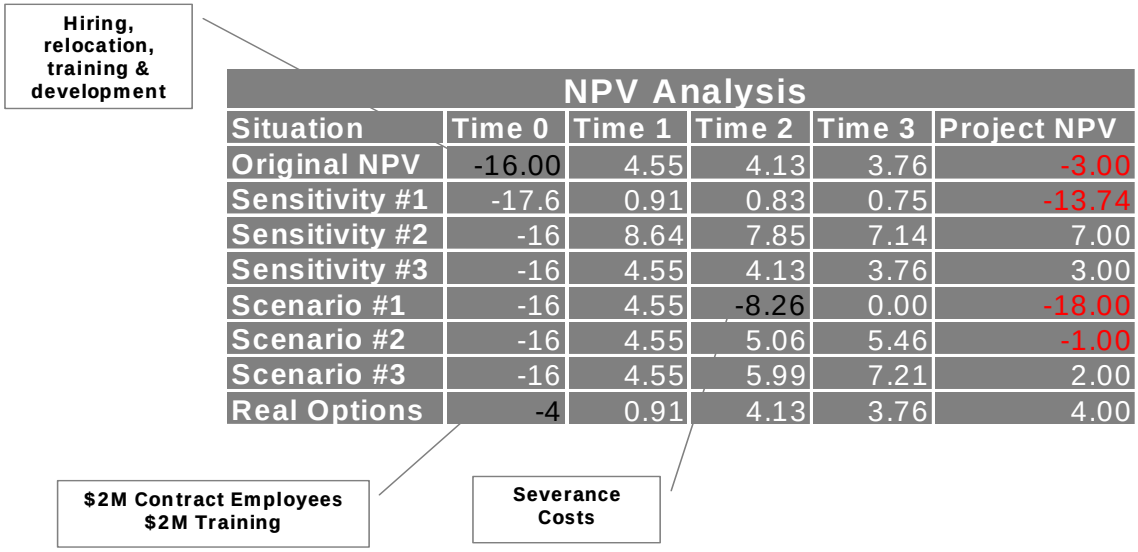
Again, returning to the example, instead of looking at the case as being a matter of hiring full-time employees, what if you considered using contract workers because of the increased flexibility and cost savings. On a project such as this, it would probably only cost about $2 M to hire 400 trained employees and they could be terminated in a year. Contract employees typically cost 10 percent more than regular full-time employees. If real-options logic is applied to this scenario, you have just been offered two options: an option to wait and an option to learn. By investing $2 million in the option to wait, you are able to hire the 400 employees you need to complete the project. The cost is substantially less than the cost to recruit, hire, train and relocate 400 permanent employees. You also have the added flexibility to terminate them in a years' time. The other option is the option to invest in training for your existing employees. Those employees who will come of the project in a year have similar skills, but cannot directly transfer to a new job. Therefore, by purchasing the option to learn and investing in them now, you will enhance the skill-base of your workforce and be able to accept the contract. The NPV is positive.



Aside from the actual values of the case, note that the main contribution of real options stems from a providing a different logic for how to handle decisions when the future is uncertain. It extends your alternatives from considering all or nothing investments with their accompanying costs and risks, to looking for more flexible options that enable you to make smaller upfront investments thereby reducing the risk.

Observations

Before making a final decision, it is important to take a step back and re-visit the output from all the analysis. The original analysis showed a negative NPV which would imply the project could not be undertaken. The sensitivity analysis showed that the NPV was most sensitive to changes in costs or benefits. This was further reflected by the scenario analysis that showed when you were able to influence benefits to the highest expected level the project return would be positive. When we look at it through the real-options lens an option besides changing benefits emerges. Costs can be impacted substantially by employing a contingent workforce and mitigating many of the start-up costs. This also results in improved skills of the existing workforce and enhanced flexibility for the uncertainties of the future.



NPV Analysis					
Situation	Time 0	Time 1	Time 2	Time 3	Project NPV
Original NPV	-16.00	4.55	4.13	3.76	-3.00
Sensitivity #1	-17.6	0.91	0.83	0.75	-13.74
Sensitivity #2	-16	8.64	7.85	7.14	7.00
Sensitivity #3	-16	4.55	4.13	3.76	3.00
Scenario #1	-16	4.55	-8.26	0.00	-18.00
Scenario #2	-16	4.55	5.06	5.46	-1.00
Scenario #3	-16	4.55	5.99	7.21	2.00
Real Options	-4	0.91	4.13	3.76	4.00

Discussion

The new analytic tools come with a host of advantages and disadvantages as well. On the positive side, they integrate strategic and analytical rigor. Strategically, the tools have elements of financial, economics and management science theories combined to enhance decision making. Analytically, the tools add another dimension of quantitative analysis to the traditional tools by considering risk and uncertainty. The new analytics are equipped to account for multiple and changing decision paths as opposed to just one. They also allow an investor to shift risk of large-scale investments until better information is available. In these ways, the new tools increase decision-makers flexibility and allow for better decisions in the face of uncertainty.

However, there are some disadvantages associated with these tools. First, there is little proven practical application. The theories are complicated and not widely understood or used in the business or human resources world. Similar to the traditional tools, the analysis is only as good as the estimates of cash flow. Also, if there is no uncertainty, there is no need to pursue these new analytic tools as the analysis reverts back to the net present value of the project.

Finally, there are limited real-options or Monte Carlo experts to provide theory, design projects and implement these tools within the business.

Traditional financial valuation approaches are incomplete when modeled under actual business conditions of uncertainty and risk. Thus, the new analytic approaches may be used to complement the traditional view to obtain a much clearer view of business reality. In this manner, it is necessary for business to use not just one of these tools, but all of them to gain a wider perspective and understanding of all the possibilities associated with a project. In this manner, decision making will be enhanced and the weaknesses of the tools will be overcome.

While these tools have traditionally been used in the financial and project management arena to make decisions, there is a place for them in the human resource function. Traditionally, HRM has found it difficult to assess the value of projects due to ambiguous information regarding causation and correlation associated with HR programs. It is difficult to assess individual worker productivity over time, transfer of training to the job, and implications of various workforce mix and modes on the business. Regardless, HRM must learn how to accurately assess project costs and returns because employee costs consistently compose the greatest percent of a firm's operating budget. Due to the high levels of uncertainty and risk associated with these decisions, these tools have wide-spread applicability to the HRM function. Using these tools will allow the HR leader a better understanding of the ramifications of their decisions and provide a means to evaluate those decisions which occur under uncertainty. The following example will illustrate how these tools can be applied to a strategic staffing decision.

Summary

Increasingly HR decision makers must apply sophisticated analytical techniques to make strategic HR decisions. Utilizing various tools and methods such as traditional cash flow, sensitivity analysis, scenario analysis, Monte Carlo Simulation and Real Options theory can help to identify the relevant cost versus benefits and valuation process over time and under conditions of uncertainty. It is important to note that these tools are valuable when used

systematically. In this manner they can build off one another and counter the disadvantages of each. Ultimately, it is the combination of the models, analytical processes, the real-options thought-processes that will provide the best decisions when faced with uncertainty.

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