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The Challenge of Valuing Early-Stage Life Sciences Companies

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Introduction

How do you value an early stage Life Sciences company that initially is mostly a scientist's idea with unknown revenue many years away after numerous approval steps and reliant on management and partners that have not even been identified yet? After a decade in the Life Sciences industry as a financial executive, investor and advisor, I can attest that valuation is extremely challenging, difficult to gain agreement on and varies dramatically between practitioners. According to Stewart (2002) some analysts admit to estimating value based on lab size, scientific staff size, "best guess", and a cost plus approach. And yet the challenge to accurately value Life Science opportunities is greater today than ever as the industry is beset by a productivity crisis and innovation gap and is addressing them through mega mergers and acquisitions, licensing and joint ventures with smaller biotech and specialty pharmaceutical companies, so accurate valuation is critical.

This productivity crisis in the Life Sciences industry has many causes. Remaining diseases without treatments are increasingly complex, large pharmaceutical companies don't seem to have the ability to tackle these remaining opportunities while small undercapitalized biotech companies do, government regulation and insurance reimbursement is changing, more cautious and more focused on low cost, and the competitive situation is far worse with larger, better capitalized firms and aggressive generic players (Hartmann and Hassan, 2005). The innovation gap is a result of numerous blockbuster drugs approved in the 1990's that are coming off patent in the last few and next few years leading to dramatic revenue declines unless new products can off-set them. Lately the average new pharmaceutical product has taken in excess of ten years to progress through development to approval, costing in excess of $900 million to do so, and resulting in successful navigation of all the regulatory hurdles of only 8% for a new drug (Hartmann and Hassan, 2005).

There has been much attention both by academics and practitioners to shareholder value analysis and the methodologies of net present value and other sophisticated methodologies such as total shareholder return, economic value added and real option analysis in corporate finance over the past several decades (Koller, Goedhart and Wessels 2005, Crombie 1997). However, at the same time there exists frustration with the applicability of these mathematically/financially oriented methodologies versus more conventional analyses such as comparable price earnings multiples, price earnings growth ratios, book value multiples and simple payback or return on investment analyses. This frustration exists to an even greater extent in research intensive industries such as the Life Sciences or High Tech sectors where forecasting cash flows with precision is problematic and where the probability of success in various stages of development seems far more important than forecasts or discount rates.

Valuing early stage Life Sciences companies: biotech, pharmaceutical and medical device companies, often with several promising but unforecastable products and often no

current revenues, is very challenging and open to wide variability. Yet managers, investors, and bankers need to do so otherwise how do they determine what companies to invest in, products to support and opportunities worth launching or partnering on. Life Sciences opportunities have multiple layers of risk and dependency, from scientific to regulatory to commercial, and in many cases several rounds of funding and license partners before ultimate market commercialization. Valuation is most often performed by way of typical net present value calculations but practitioner frustration with extremely unpredictable revenue and expense streams numerous years in the future with several stages of development beforehand have led some to consider alternative valuation techniques such as Monte Carlo simulation, real option analysis and comparable multiples. This paper will explore some of the challenges applicable to valuation in the life sciences industry, describe some alternative valuation methodologies, analyse and compare them and apply them to a case study of a current Canadian life sciences company seeking strategic alternatives ranging from investment to sale to IPO. The author has been a corporate executive and private equity investor in the life sciences sector for the past decade and knows by experience the challenges and frustrations of valuing the early stage high risk but often high reward opportunities.

There exists a great deal of academic research and practitioner writing on the strategy formulation, management and organizational aspects of research and development ("R&D") intensive and technology intensive businesses such as life sciences and high tech companies (Jagle 1999). However, there has not been adequate analysis and acceptance of the appropriate valuation mechanics. Bankers, equity analysts and venture capitalists use peer group analysis, comparable multiples and discounted cash flow ("DCF") approaches. Looking at peers and comparable multiples is unhelpful however if the companies and the scientific developments, technology or products are differentiated, which is usually the case for innovative companies. Multiples are very challenging if there are only losses to multiply! Dependency on traditional valuation mechanics such as net present value ("NPV") or DCF have been met with frustration because of the difficulty in predicting cash flows for a product that will be launched numerous years in the future after numerous development and approval stages (Jagle 1999, Stewart 2002). For a pharmaceutical product that needs to progress through several clinical trials (formulation, Phase 1, 2, and 3) and approvals the probability of success changes at each stage. The use of these changing probabilities and the different risk factors leads to an argument about using different discount factors and risk probabilities and if doing so is double counting risk. Option trees or decision tree probability analysis is often used in these situations (Jagle 1999). Given the wide variability in potential outcomes many practitioners utilize scenario analysis or Monte Carlo simulation to address the breadth of possible outcomes (Jagle 1999). Recently real option analysis has been recommended by many academics as the theoretically best valuation methodology given the stages of development and the wide variability of outcomes but the lack of knowledge of how to apply real option analysis and the lack of comfort with it in Boards of Directors and with decision makers has hampered its wide usage (Hartmann and Hassan 2005). Sometimes valuation in the life sciences industry seems like more "gut feel" than based on rigorous analysis.

This paper will begin with a review of some of the literature on the subject of shareholder value and valuation in similar R&D intensive industries and more fully describe the risks. We will then detail the various methodologies and briefly explain their use and compare their applicability. We will then apply the various methodologies to a current case study of a Canadian Life Sciences company that is exploring its strategic alternatives including taking on a minority investor, partnering, selling out or executing an initial public offering ("IPO"). Finally, we will close with some conclusions and recommendations for practitioners in the life sciences arena.

Literature Review

The conceptual framework for many of the shareholder valuation approaches used by investors and the business community today are based on the framework detailed by Rappaport (1986) and included in a series of popular books on valuation by several McKinsey consultants (Koller, Goedhart and Wessels 2005). These approaches simply recommend that a company perform a DCF valuation of its projected cash flows using the appropriate cost of capital and invest in opportunities as long as the NPV is positive. Both approaches also try to simplify the valuation process into value drivers to better understand the sources of value. For Rappaport (1986) the value drivers are: sales growth, profit margin, capital expenditures, working capital investment, tax rate, discount rate and competitive advantage period. Others simplify these value drivers further to EBIT margin, capital turnover and ROIC. Koller et al (2005) added a helpful strategic framework that recommended breaking down company valuations into the stages outlined in Table 1 which allows the dissection of the sources of value creation by corporate strategy. This dissection of the valuation into its component parts often provides critical understanding of the sources of value, what managers can do to increase value and where unexploited opportunities exist. One point estimates of value are not nearly as helpful in understanding a corporate strategy as this dissection of value.

Table 1: Corporate Strategy Framework

1. Current market value
    a. Perceptions gap
2. Value as is
    a. Operating improvement
3. Value with internal improvements
    a. Disposals / new owners
4. Value with internal improvements and disposals
    a. New growth opportunities
5. Value with internal improvements, disposals and growth
    a. Financial engineering
6. Total Potential Value

Source: Koller, Goedhart and Wessels 2005, page 26

While the importance of projecting revenue, expenses and investments into the future is obvious and is performed by business people independent of any DCF analysis, as is understanding the drivers of the business such as profitability, growth or capital investment, the critical issue in the recommended shareholder value methodology is discounting those projected cash flows at an appropriate cost of capital to arrive at an NPV. Wide disagreement occurs on what is the appropriate cost of capital, an industry's, a company's, a project's, one with added points to ensure extra return, one based on short term risk free rates and equity risk premium or long term ones and esoteric discussions on how best to determine the equity risk premium over time, market leverage or book leverage and average leverage versus actual leverage. The confusion is based on limited or confused understanding of the Capital Asset Pricing Model ("CAPM") and its components, Beta, the market risk premium and the impact of leverage.

Some academics have argued that excessive reliance on DCF based shareholder value analysis has caused American companies to be excessively short term oriented and because of high hurdle rates, bias companies against investment (Jagle 1999, Crombie 1997). Others have argued that it is the misapplication of risk that causes problems (Jagle 1999). With experience and greater knowledge risk later in a project should decrease and therefore discount rates should as well, yet practitioners continue to use one discount rate throughout their projections. This is particularly a problem in the life sciences business because as a product progresses through its development stages, the risk of successfully completing the successive stage declines dramatically. Others have argued that when one stage decreases the risk of a successive stage real option analysis is a more appropriate valuation tool than simple DCF. Achieving one stage provides the option of proceeding with another stage, but not the necessity, if the development is unsuccessful, similar to buying a financial option in the market. Jagle (1999) points out that growth stocks have often traded at Price Earnings multiples higher than others, and higher than their known DCF would justify, suggesting that the market is applying a premium to the stock for its growth options. Myers (1984) went so far as to say for R&D companies "the value of R&D is almost all option value" and compared financial options to the companies real world options and created the phrase "real options".

Valuation in the Life Sciences Industry

In The Life Science industry, because of the lack of known revenue, the timeframe and the numerous risks, valuation is very challenging. According to a Pricewaterhouse report on Biotech Valuation, the value of many high-tech companies is all in their intangible assets such as intellectual property ("IP") and knowhow not in their tangible assets yet biotech is even more challenging because converting their IP into revenue is subject to substantial government regulation and several approvals (Bratic, Tilton & Balakrishnan). Specific risk issues that need to be considered when valuing Life Sciences companies include:

1. They may not have any products on the market (and may never)
2. Need to successfully formulate a product that works

3. Need to successfully complete clinical studies and then gain regulatory approval for the product which typically includes:
    a. Phase 1 Safety Studies
    b. Phase 2 Proof of Concept Studies
    c. Phase 3 Pivotal Efficacy Studies comparing the product versus placebo
4. For most smaller companies, license/partner negotiations with a commercialization entity that has the manufacturing and marketing skill
5. Post marketing studies comparing the product to best in class competitive products
6. Negotiation for reimbursement with Managed Care/insurance organizations
7. Commercial success in the marketplace
8. Life of IP before patent expires/invalidated and subject to generic competition
9. Changing government regulation and policies

Finally, most new product development in the Life Sciences industry is performed by small start up companies with lack of management or experience and significant annual cash burn issues, yet the cost of developing a product is in excess of $100 million (Bratic, Tilton & Balakrishnan, 2000) over a several year time frame with the ultimate commercialization dependent on successful negotiations with a larger partner. The long time frame, the risk of success dependent on external entities and the dramatically different levels of risk and appropriate leverage during the development, make a DCF with one projection and one discount rate intuitively problematic. As the famous Princeton professor of Statistics, John W. Tukey, is credited with coining, "it is better to be approximately right rather than accurately wrong." With projections they can't believe many practitioners rely on gut feel and simple comparables instead of NPV.

Valuation Methodologies: The Math

While the math in applying different valuation methodologies is taught at most business schools and therefore well known, many of the pitfalls in its application, particularly in its application to the Life Sciences industry needs to be explained and understood to ensure appropriate calculations and decisions.

1. Discounted Cash Flow and Shareholder Value Analysis

Several years before the approval of a Life Sciences product it is virtually impossible to make one projection for the revenue of the product as the efficacy of the product is not known relative to the competition and reimbursement and competitive pricing is not known. Many practitioners find it useful to perform several projection scenarios based on different comparable penetration rates relative to other successful products in the marketplace of comparable sales ramp up such as: a blockbuster, a mid tier product and a "dog". Kellogg et al (1999) recommend five scenarios, Breakthrough with peak revenue of $1.3 billion, above average with half the revenue of $660 million, average with one tenth the revenue of only $66 million, below average with revenue of $7 million and a "dog" with revenue of $6 million. They then suggest the average projection has a probability of 60% and each other one a probability of 10% (Kellogg et al, 1999). This

results in expected peak revenue of only 18% of the projected block buster or $240 million. The point is that likely sales for most pharmaceutical produts are much lower than the dreamed for block buster sales, 90% of the time.

Expenses also need to be projected by scenario. While there are unquestionably some fixed costs, many marketing and promotional costs in the Life Sciences business are directly variable to sales. Kellogg et al (1999) based on their analysis use gross margin of 74.5%, marketing that is 100% of sales in the first year of launch, 50% in year 2, 25% in years 3 and 4 and 20% thereafter. Fixed costs they estimate at 11.1% and working capital at 17% of sales. The shocking expense to most is how expensive it is to market at product at launch because of large sales forces, lots of promotion and lots of advertising. Each of the scenarios is net presented valued and multiplied by as assessment of the probability of the scenario coming true based on industry or company standards.

The appropriate discount rate to use for Life Sciences businesses is subject to much discussion (Stewart 2002). The riskiness and leveragability of a project at its inception, after successful clinical trials, and after approval, are dramatically different. Many practitioners therefore believe it is appropriate to use different discount rates before and after approval/launch and some will use different discount rates for each stage of development. The risk of a product goes down dramatically and it can attract substantial leverage after approval and particularly once the product has been partnered with a commercial party and launched. Discounting post approval cashflows by a standard weighted average cost of capital ("WACC") using comparable leverage, Beta's and costs of debt, back to the date of launch or approval, is appropriate and standard in the industry. However, how to discount that NPV from the date of approval back to the present is where many practitioners disagree. Before approval and launch the project has limited if any debt capacity. The risk of progressing through each phase of clinical trials is high but declines as the development completes successive phases. Therefore, many practitioners will not use a WACC for preapproval discounting but an appropriate for the risk, cost of equity, and some will use different and higher ones for each earlier stage of development.

Some analysts will perform very detailed product projections post approval, present value them to the expected approval date and then discount them to the present by a perceived discount factor of 25 to 50% to take into account both high development risk and the probability of approval (Bratic, Tilton & Balakrishnan, 2000). Some commentators have argued that an overreliance on DCF particularly when using too high discount rates has caused American companies to dismiss positive NPV projects and to be overly short term oriented. By adding unjustified extra points to a discount rate practitioners will increasingly undervalue longer term opportunities. Clearly, better methodologies for valuing Life Science opportunities or better application of existing ones are needed.

Probably the biggest area of debate over the application of DCF to valuing a firm is the calculation of the terminal value ("TV"). The TV is the value of the firm into perpetuity after the explicitly projected planning period. Numerous different formulas are used to calculate TV such as the perpetuity growth formula which calculates the value of a

certain cash flow growing forever at one growth rate. Often practitioners will test the TV calculation by calculating the effective earnings multiple at that time or project out into the future and calculate if the NPV is different than the TV and if the projections are reasonable. With TV often providing the majority, or the vast majority in growth companies, of the total valuation of the firm or project, the dependency on this one calculation is very concerning to many practitioners. Debates over growth, discount rates, when the stabilized period of projections has been met, return to the average or mean level of profitability or Return on Investment increase the discomfort with the TV calculation. When days of work and effort go into projecting year by year the revenue, expenses and cash flows of the first five or ten years of the proforma but then a majority of the value comes from one formula, fcf / d – g, the eyes of board members roll.

A final area of concern in the application of DCF is the calculation of the WACC where leverage changes over time. Many firms will have high leverage at one time and have as an objective to pay it off, particularly if the company was a leveraged buy out but also firms making significant acquisitions or expansions, performing recapitalizations or going through restructuring. There is also discomfort with the math behind the calculation of Beta's in the WACC calculation and levering and unlevering them. Some practitioners therefore feel more comfortable discounting the projected cash flows at the unlevered cost of equity. Separately they will then value the benefit of the tax shield from debt. That allows the project or firm to be valued into the components of its operating value and the value from financial engineering or leverage.

2. Monte Carlo Simulation

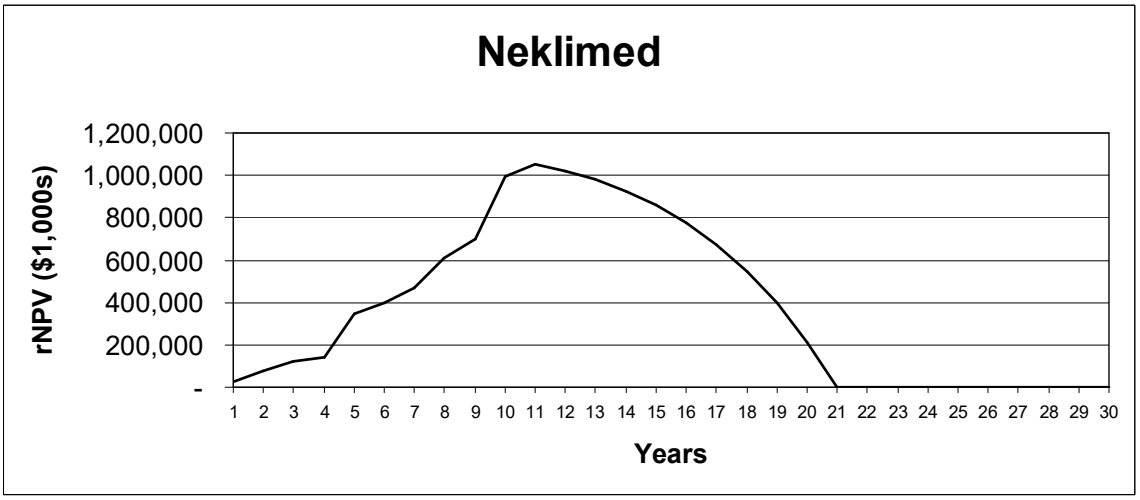
Given the unpredictability of the revenue forecasts, penetration, pricing and of the expenses, some practitioners will engage in computer based Monte Carlo simulation. Monte Carlo simulation is performed by determining the ranges of outcomes for several critical variables (i.e. approval success, launch date, market size, penetration, price, gross margin, contribution margin, fixed cost etc.) and the probability distribution of each occurring. A computer model is then utilized to determine the range of outcomes and a point best estimate based on simultaneous changes in all of the variables. Decision makers' frustration with Monte Carlo simulation is that while appearing very scientific and technologically sound, it is difficult to judge for reasonableness. The one point estimate of so many variables is too much of an average that it may not reflect anywhere close to anyone scenario and therefore not be believable. While often calculated, most decision makers prefer scenario analysis over Monte Carlo simulation so they can chose which scenario, or average or probability of several scenarios they believe most likely and not leave that judgement up to a computer.

3. Decision Tree or Option Tree Analysis

The probability of achieving each stage of development/approval has been tracked over time and even though every company hopes and plans on higher than industry standard success, many will use the average success rates to determine their chances of progress for each stage. These probabilities lead to the ability to build a decision tree or option tree

which analyses the probability of gaining approval for that phase and the option to continue to the next phase of clinical study and approval versus terminating the project and all investment. The cost of that clinical trial is the option price or cost of that estimated value. For example, if the NPV of a launched product was $1 billion, the probability of successful Phase 3 clinical trials and thereby approval was 80%, and the cost of the clinical trial and submission was $100 million, then the NPV of the Phase 3 step would be $700 million. Then that $700 million NPV, discounted back for the year to complete the Phase 3 trial and the year to file and wait for approval, would be similarly used in a probability assessment for Phase 2, and so on back through each stage of development. Many practitioners prefer this approach because they can see how a sizeable NPV market opportunity at launch can be reduced to the present by time and by probability of failure of each successive stage of development. They can also decide if they know something that would cause them to use other than industry standard probabilities for success at each stage. By incorporating these industry standard probabilities into each stage of the option tree they can use more intuitively reasonable discount rates that take into just market risk not technical or approval risk, to discount the option tree NPV's back to the previous stage and to the present. Finally, an option tree makes explicit that a decision to proceed with a development program does not necessitate continuing with it all the way to launch and incurring all the projected costs, because if the product fails at any stage the decision can be made to not proceed to the next stage, provided real options for the company as it mover through its products development.

Stewart (2002) concludes that risk adjusted NPV ("rNPV"), where each of the valuations of each option or scenario is multiplied by its probability and summed is the best methodology to value biotech companies. He bases his conclusion on industry standard success rates for each stage of clinical trials and approvals such that values should be risk adjusted and discounted at standard market discount rates rather than previously used inappropriately high ones. Tufts University publishes standard success rates for reaching the next level of development which are 20% for those that enter Phase 1, 30% for Phase 2 and 67% for those that enter Phase 3. Only 80% of all drugs that pass phase 3 are eventually approved by the regulator. This results in a total preclinical to market probability of probably less than 10% given that some early failures will never be reported (Stewart 2002). Kellogg et al (1999) provide probabilities for each stage, not cumulative to launch of the following: Discovery 60%, Pre clinical 90%, Phase 1 75%, Phase 2 50%, Phase 3 85%, FDA approval 75% and Post Approval 100% (Kellogg et al, 1999, page 3). The product of these probabilities would be 12.9% probability of each product entering the discovery stage being launched. The graphical result of a rNPV curve over time for a firm Stewart (2002) analysed, Neklimed, illustrates how the value of a pharmaceutical product jumps at each approval but then increases slowly for the time value of money before reaching a further valuation event.



Source: Stewart 2002, page 12.

4. Real Option Analysis

The option tree methodology has led some academics to suggest using financial option techniques to value each stage of development, or real option analysis. The application of this technique may make obvious sense as companies with a portfolio of projects have options to proceed to the next stage with costs and expected values. However, academics disagree about the technique that should be used, Black Scholes or other less well known valuation methodologies such as binominal lattices, decision makers and Board of Directors are not familiar with or comfortable with the methodology and the investment community where financial sophistication should be the greatest, have not adopted this methodology. In a survey of pharmaceutical companies and their use of real option analysis, Hartmann and Hassan (2005) concluded that "the real options revolution anticipated by Coy (1999) has not become true so far for valuation in pharmaceutical R&D [and]…this event is not expected in the mid-term, if ever" (Hartmann and Hassan 2005, page 352).

5. Comparable Multiples

There is still a great deal of attention paid by Wall Street and practitioners to more simplistic valuation methodologies of comparable multiple such as comparable price earnings multiples ("PE") where the stock price divided by the earnings per share ("EPS") of different companies are compared or the more recent attention to the price earnings growth ratio ("PEG ratio") where the PE is divided by its EPS growth rate. For early stage companies sometimes analysts will project the third year or so after launch, apply a comparable PE multiple to value what the product or company should be worth and then discount back to the present at extremely high discount rates to take into account both time and risk of approval. For pre-revenue companies an inordinate amount of attention is paid to the probability of success in the next stage of development and the cash burn rate, which might suggest that real option analysis would be a suitable methodology. However analysts will just look back to what the last comparable product

in that area was worth. For post-revenue Life Sciences companies, earning growth and the comparable PE ratio seem to gain more attention than any other methodology. For practitioners and decision makers DCF calculations are performed but values are always then subjected to a PE multiple comparisons to finalize value assessments. Maybe the conclusion is that NPV's are what an opportunity is worth but the PE multiple says what the price should be.

Case Study – Meditech International

Meditech International is a private Canadian medical device company that has developed a Low Intensity Laser Therapy utilized for sports injuries, arthritis, back pains and numerous other medical issues. The company sells and distributes is equipment worldwide, but primarily in the United States and Canada, has developed many well accepted procedures fro the therapy and also operates two clinics in Toronto, Canada. The founder of the Company and effective 100% owner, Dr. Fred Khan, is one of the world's leading experts on the use of Laser Therapy for medical purposes and provides presentations on its use and has written numerous scholarly and popular articles and a three volume book on the Laser Therapy. In addition, the Company spends a significant amount of money performing R&D into both new applications and appropriate diseases for its therapy as well as improvements in its equipment, which requires regulatory approval before sales and the processes and procedures for the use of the equipment with different patient issues and diseases. The scientific premise for the therapy is that certain spectrum of light, when focused via a laser and penetrating the skin, causes the natural healing of the cells to occur far more rapidly.

Dr. Fred Khan, the founder, president and chief medical officer of Meditech, is 80 years old and is interested in crystallizing the value of his company through exploring strategic alternatives which range from bringing in a significant minority investor, forming a joint venture, selling control, selling 100% or going public via an IPO. The Company is structured into two divisions, the two clinics and the equipment marketing company, both of which are profitable. However, the profit of the equipment company is low because of a significant expenditure on R&D on new products and procedures. Based on his life time of dedication to the business, his perception of where comparable biotech and medical device companies trade, Dr. Khan believes the value of his Company is $20 million. Based on a DCF of a simple extraction of a two year budget prepared by his controller, the NPV is $4.2 million. Based on Dr. Khan's belief in how new younger energetic management can increase the sales of his business and what his new products and new processes can deliver in revenue the NPV would be between $10 and $12 million. A compelling argument made by many practitioners when faced with the indeterminable value of R&D is to at minimum subtract its expense from the calculation of the value of the business As Is as R&D if it was worthless would logically be terminated. If R&D was zero the value of Meditech As Is would be 50% higher or $6.3 million.

There are two good Canadian comparable companies but both are EBITDA negative with significant R&D expenses and fixed expenses. Both are public companies, producing revenue that attracted capital before the economic challenges of 2008-2009 but have

suffered significant stock price depreciation since then and have found it challenging to raise cash in the current market environment. There are two American comparables, one public, one private, but both significantly greater in size and diversified in product offerings. The challenge in working through the valuation of Meditech is complicated by the Canadian comparable companies that went public at extremely high valuations based on the markets then valuation of the significant opportunity in laser therapy, albeit in far better markets for Life Sciences companies generally, and while they have declined precipitously in the past 18 months, they have done so because of losses and new focus on cash burn.

This case example is not untypical of many Life Science situations. A private company with some private and some public comparables. Different businesses embedded in one company. Currently marketed products making attractive margins but offset by a significant R&D expense. The R&D opportunities are subject to risk of scientific success, regulatory approval, reimbursement approval and commercial success, potentially dependent on an as yet to be negotiated commercialization or distribution deal. All complicated by the organizational reality of a critical founder scientist that knows all the players in the industry and the challenges in developing good products but maybe not the best business person to market and manage an increasingly large and complex business.

The valuation procedure followed here by the financial advisor hired to explore strategic alternatives was multi-fold with several different valuation methodologies followed. First the existing clinical business was valued. Second the equipment businesses projections were adjusted to exclude R&D expenses. Third the identified growth opportunities for the existing business were separately modeled to allow a valuation of the business As Is and a value of the business with growth opportunities. Fourth, the several different R&D opportunities were independently projected allocating departmental R&D expenses to each of the projects. Then an option tree analysis was performed where each opportunity was valued based on comparable product values and multiplied by management judgment as to success and reduced by the allocated R&D expense. The option tree was used over Monte Carlo simulation or a scenario analysis because the founder felt very comfortable predicting the probability of each products success and did not feel comfortable with the alternative. Real option analysis was not even a possibility with this client. All of these separate valuations were added together to arrive at a full valuation of Meditech. Finally, comparable revenue multiples were applied based on the two Canadian comparable companies and revenue and PE multiples based on the American comparable and a wider segment of all medical device companies. The comparable analysis was very date sensitive as the historic comparables suggested a price nearer the $20 million perceived value by the founder while the current comparable multiples were far closer to the current adjusted NPV of $10 – 12 million.

Conclusion

There is a gap between the shareholder value methodologies taught in business schools and described in academic articles and those practiced by business people and the investment business. The academic recommendation is for a highly mathematical,

financial methodology based on CAPM, DCF and real option analysis. Practitioners utilize DCF but subject them to checks with comparable multiples and dissect the valuation so that management judgement can be applied to critical assumptions such as probability of R&D success, rather than allow a sophisticated computer or Black Scholes model to provide the answers. Some of the distrust of the more financially oriented methodologies is because of inappropriate application of the techniques, such as too high discount rates, too much dependency on the TV calculation in the total valuation, and inappropriate leverage assumptions. It would be wrong to go as far as saying that valuation is more of an art than a science, but it is appropriate to say that a great deal of judgement is required to perform a valuation of a firm or a project and not just the mathematical application of some formulas in a computer spreadsheet. Practitioners need to ensure that they take the time to understand their projections and valuations, the critical value drivers and the component parts of the value, and apply their experience and judgement to the numbers.

Based on the literature reviewed, the author's past experience in the Life Science industry and the analysis of the Meditech case study, the following recommendations are made for valuation in the Life Sciences business:

1. Value any earnings positive division or business separately with R&D expenses excluded using a DCF. If the product's patent will expire and thereby be subject to generic competition, which is likely, project the entire revenue cycle including the decline and do not add any terminal value.
2. Value any R&D projects independently using scenario analysis for the commercial period and an option tree process for the development stage which allows management judgement on the likelihood of success or the use of industry standard success, and not technical risk adjusted high discount rates.
3. Use equity discount rates prior to approval with no or little leverage and if leverage changes dramatically post approval value the post approval projects also with equity discount rates and value the tax shield from debt separately.
4. Do not add extra points to the discount rates, it will bias against long term attractive projects.
5. Subject all terminal value calculations to reasonableness tests with comparable multiples and believability.
6. Subject all valuations to reasonableness tests with comparable multiples.
7. Exercise management judgement on the projections and the valuations, don't allow the computer and the math to fool you into believing the result without critical review.

Bibliography

Baum J, Calabrese T and Silverman B, Don't go it alone: Alliance Network Composition and Startups' Performance in Canadian Biotechnology, Strategic Management Jounal, 21, 267-294, (2000).

Bratic W, Tilton P and Balakrishnan M; Navigating through a Biotech Valuation, Jounal of Biotechnology 1997.

Crombie B; The Seven Deadly Sins of Shareholder Value Analysis; The Canadian Treasurer Magazine, November 1996.

Hartmann M and Hassan A, Application of real options analysis for pharmaceutical R&D project valuation – Empirical results from a survey; Research Policy 35, (2006) 343-354.

Jagle A, Shareholder value, real options, and innovation in technology-intensive companies, R&D Management 29, 3, 1999.

Kellogg D, Charnes, J and Demirer R, Valuation of a Biotechnology Firm: An application of real-options methodologies, Research paper presented at the 3rd Annual Real Options Conference, June, The Netherlands, 1999.

Koller T., Goedhart M, and Wessels D; Valuation, 4ed (University Edition), John Wiley & Sons (2005).

Porter, M.E. (1980) *Competitive Strategy*, Free Press, New York, 1980.

Rappaport A, *Creating Shareholder Value: A Guide For Managers and Investors*, Free Press, 1986.

Stewart J, Biotechnology Valuations for the 21st Century, Milken Institute, 2002.

Wong K. M., Valuation and Acquisition, slide presentation for the course Valuation and Acquisition at International School of Management DBA course, November 2009.