VALUATING BIOTECH PROJECT PORTFOLIOS USING CRYSTAL BALL AND REAL OPTIONS – CASE: NATIMMUNE

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ABSTRACT

Venture capital companies and other investors are not willing to rely on promises of a new blockbuster drug 10-15 years in the future. Therefore all biotech companies are faced with the challenge of valuating the R&D projects in their pipeline in a realistic and persuasive way. Traditionally simple discounted cash flow models are used to valuate the potential of a project portfolio. This method however has its flaws since it assumes a strategic vacuum in the whole calculation period. Today new methods can be used to calculate the value of strategic alternatives and market risks. Using simulation and real options techniques, the value of strategic possibilities (i.e., sell or joint-develop) and risks (i.e., market uncertainties) can be quantified resulting in much more realistic, persuasive, and precise valuation of projects.

1 INTRODUCTION

NatImmune is a biotech company focusing on the development of protein-based therapeutics for the prevention and treatment of infectious diseases and inflammation. NatImmune has a strong scientific foundation, an experienced pharmaceutical development team, a strong intellectual property rights portfolio and three unique and closely related products under development. The lead product is based on replacement therapy in patients carrying genetic pre-disposition to infections through a defect in the immune system. The second product is being developed for the prevention of reperfusion injury following cardiac surgery.

As most biotech companies NatImmune rely on venture capital companies and other investors for funding of the R&D projects in the pipeline. It is therefore vital for a biotech company like NatImmune to be able to quantify the value of R&D projects – not only for investors, but for management purposes and resource allocation as well. Biotech companies therefore need a model that incalculates both the risks, strategic options and market uncertainties they face (see Figure 1). IntelliGlobe Aps have created a generic biotech model that does that. The model is presented in the following NatImmune Case.

![Figure 1: A typical situation for a biotech company](image-url)
Traditionally simple discounted cash flow (DCF) models are used to valuate biotech projects and project portfolios. Here an expected positive future cash flow from drug sales and a negative cash flow from drug development is discounted using a weighted cost of capital (WACC). If the net present value (NPV) of the positive cash flow exceeds the net present value of the negative cash flow the project is funded.

Realizing that this is too simple and a very unrealistic approach some investors and biotech companies adjust the NPV with the accumulated expected success rates of the stages in the R&D phase. The resulting expected NPV (ENPV) is a more realistic valuation, but still merely a down adjustment of the calculated NPV. The ENPV approach is also a too simplistic and misleading valuation. To mention only some of the problems with the traditional approaches:

- Using the same discount factor (WACC) in both the R&D phase and the market phase
- The flaw of averages using the WACC – an intangible approach to in-calculate uncertainties
- The difficulty of estimating the WACC when no identical portfolio exist
- Assuming an all-or-nothing strategy at the starting point of the investment – a strategic vacuum

As illustrated in the matrix below a DCF approach would be appropriate if there were no uncertainties and a minimum of risk. If we were in a situation with little uncertainty and a number of measurable risks a decision tree may be appropriate. But in the biotech world we have a high degree of market uncertainty (number of patients, cost of treatment, etc.) and a relatively high degree of risks in the R&D phase (success rates in different stages, possibility of FDA approval, etc.). In this situation Monte Carlo simulation and real options valuations are appropriate.

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**Figure 2: Monte Carlo simulation and Real Options Valuation are the right approaches when valuating biotech projects**
A MORE COMPREHENSIVE AND REALISTIC VALUATION APPROACH

By using Monte Carlo simulation techniques we are able to quantify market uncertainty in a more tangible and pragmatic way. Market size estimations are made up by a number of parameters for the indications targeted with the R&D projects. Market driver parameters like number of patients, recommended dosage, etc. and cost driver parameters like cost of goods sold (COGS), sales force need, facilities, etc. for each indication are all uncertain estimates that make up the expected future positive cash flow. Being able to incorporate uncertainty on each of these parameters and then using simulation to quantify these uncertainties gives us a more realistic estimation of the future market size and market revenues.

Real options techniques enables us to analyze and put value on strategic possibilities and hence the strategic flexibility that we have in the R&D phase. This means that we are able to put value on strategic options like for example:

- Abandoning the project if tests fail or expected returns are not lucrative
- Sell a project for down payments, milestone payments and royalties
- Engage in a joint-development agreement to split costs with partners
- Expand or wait to achieve better test results and increase success possibility for FDA approval
- Going to market and establishing own sales force, etc.

Using real options techniques we can calculate the value of the strategic flexibility that these options represent. We can put value on all the strategic options or analyze one particular strategy given all the uncertainties we face. In other words the real options approach allows us to do decision analysis on very complex cash flow calculations and not assume a strategic vacuum in the R&D phase of projects in the pipeline.

Furthermore the real options approach is a risk neutral approach since it takes uncertainty into account using a constant volatility estimate to calculate asset development over time. In this way strategic possibilities can be quantified without being eroded by a very high average discount factor.

Since the approach is risk neutral and options are only used if they are rationally economic justifiable (in-the-money) the NPV using a real options approach is the same or higher and less risky then the NPV using the DCF approach as illustrated in the figure below.

![Figure 3: DCF vs. Real Options a risk-return comparison](image-url)
4 THE NATIMMUNE CASE MODEL

The real options portfolio model is a strategic decision support tool, where biotech projects can be valued and the strategic alternatives quantified. The model is developed in order to visualize and analyze complex decision problems in a clear and transparent way. The model enables the user to focus on analysis and interpretation of the results instead of modeling and computation of the problem.

The Real options Portfolio model for NatImmune is a dynamic and flexible spreadsheet model that enables NatImmune to analyze strategic decisions regarding a particular project or the entire project portfolio. The model enables NatImmune to add, change or in other ways alter their project portfolio, potential indications, market sizes, etc. without having to think about the impact on formulas and calculations. It is possible to change the model at any time and then automatically make the necessary changes and calculations on the model.

NatImmune are able to analyze the following key figures for the portfolio or a specific project:

- The expected cash flow and ENPV
- The expected cash flow for a selected option and ENPV for a selected option
- The aggregated value of all the strategic options for each project in the portfolio

The model is made up of project definition tables and automatically generated cash flow views where cash flow is presented both in tables and graphically. Any number of projects and indications can be added to the portfolio. For each project in the portfolio a number of milestone options can be added and analyzed. The following screen dumps illustrate some of the model features.

The model is set up so that R&D projects and Indications (markets) are defined in a set of tables and matrices. In any part of the project definition or market size estimation uncertainties and correlations can be applied using Crystal Ball® (Figure 4).

![Figure 4: Set up of the R&D project portfolio](image)

The resulting cash flows are all generated automatically and can be presented in tables or graphically (Figure 5). All cash flows are calculated per quarter and are summarized per year. Cash flow uncertainties can be simulated using Crystal Ball:
For each project in the portfolio a number of options can be entered at different mile stones in the R&D process (Figure 6). When down payments, mile stone payments, royalties, cost splits, etc. are entered the option value and NPV including the option value are calculated automatically. At the same time decision lattices and graphical illustrations of different strategic paths are generated. Using goal seek and a scenario analysis functionality added to the model NatImmune can analyze the feasibility of different partner strategies, identify acceptable royalty ranges, etc.

All complex cash flow calculations are hidden, but can be analyzed in detail if the user wishes to do so. As the focus of the model is decision support and flexibility the model is simple to use and very easy to modify by simple menus and toolbars.
5 CONCLUSION

Like all biotech companies NatImmune are faced with the challenge of valuating their R&D projects as realistic as possible. Market uncertainties, risks and strategic options need to be included in the valuation of projects. In order to do so NatImmune have implemented a model that incorporates Monte Carlo Simulation and a real options approach.

The approach was new to both investors and NatImmune management, but was quickly welcomed and proved to be valuable for board meeting discussions, managerial decisions and partner negotiations. As CFO Troels Bierman Mortensen put it “We are now able to visualize and quantify strategies to support our decisions in a very persuasive and detailed way. We intend to use the approach to do different analysis on market assumptions, partner strategies, resource allocation and for investor relations communication. Apart from that it has also been a learning process for us where we now consider uncertainties and correlations in a way we did not do before.”

CFO Troels Bierman Mortensen recommends the approach, but continues “Since the approach is quite complex it is very important to take one step at a time and familiarize yourself with one part of the approach before you move on to the next. Further it is a good idea to simplify as much as possible by setting up assumptions and then doing sensitivity analysis on these successively afterwards.”

REFERENCES

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BIOGRAPHIES

Aaren Ekelund is Partner and Managing Director at IntelliGlobe Aps in Denmark. He has a MSc in Economics and Business Administration from The Aarhus School of Business / Harvard University and a BSc in Business Administration and Computer Science from The Aarhus School of Business / University of Technology Sydney. He is a former Manager and Senior Strategy Consultant with Future Lab Business Consulting, a former Senior Management Consultant with Valtech, and a former Senior Management Consultant with Accenture. In corporation with a number of Scandinavian companies he has conceptualized and developed a generic business modelling tool for advanced business case and cash flow calculations. The business modelling tool incorporates Decisioneering’s forecasting, simulation and optimization tools.