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***“What are the different obstacles involved with the implementation of Real Options Valuation technique?”***

**A case study conducted in company X in Sweden.**

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## **ABSTRACT**

In much of the recent times the practitioner's fraternity has been focused towards making investment decisions, based on traditional financial evaluation techniques ranging from Net present Value (NPV), Internal Rate of Return (IRR), Pay Back Period, Profitability Index. Although these techniques have performed satisfactorily and have provided practitioners' insights about how to value investments and thereby providing them a holistic view of the project and making informed decisions. However, these traditional techniques have focused more on quantifying the risk assessment done at the beginning of the project, by taking into consideration an optimal discount rate based on the firm's overall cost of capital, and the additional risk associated with the given project. Nevertheless, these traditional Discounted Cash Flow (DCF) techniques, fails to take into account the value of managerial flexibility in business environments associated with a high degree of uncertainty, thereby not encapsulating the value of different options which are embedded within the project, that managers possess and the value of new information during the project lifecycle. In order to value these options, Real Options Valuation technique has been proposed, which predominantly traces its origin from valuing financial options. Though various academicians have supported this technique and the potential benefits it offers to organizations while making investment decisions, it still rests on a number of assumptions, which needs to be validated across different businesses. Therefore, this study focuses on understanding the obstacles involved with the implementation of Real Options Valuation technique, based on the three roadblocks identified by Lander and Pinches (1998).

A qualitative study using semi-structured interviews was conducted within a given case company X in Sweden. Wherein based on the existing financial evaluation technique that company X uses while making investment decisions are analyzed. Based on the responses provided by the company X officials, the study revealed that company X employs traditional financial evaluation techniques, since they are been widely accepted across a wide range of industries, and also decision makers, and shareholders tend to prefer a probabilistic risk assessment at the beginning of the project, however company X do acknowledge the potential benefits offered by Real Options Valuation technique, but they are not been implemented, because of its ignorance among the key decision makers, coupled with complex mathematical calculations and various assumptions that needs to be incorporated while using Real Options approach for valuing investments, which makes it difficult in the context of given company X for using Real Options approach for valuing investments.

**Keywords:** *Project Finance, Project Evaluation, Net Present Value (NPV), Internal Rate of Return (IRR), Real Options Valuation, Options Valuation.*

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## Chapter 1 – Introduction

*“It has been my experience that competency in mathematics, both in numerical manipulations and in understanding its conceptual foundations, enhances a person's ability to handle the more ambiguous and qualitative relationships that dominate our day-to-day financial decision-making”.*

Alan Greenspan, (2005) Former Chairman Federal Reserve Board of  
The United States of America.

As Mr. Greenspan discusses the role of mathematics in today's dynamic world of financial decision making. The given study throws light on the various financial tools and techniques that decision makers possess, while making investment decisions. The first chapter provides a background about the context of the given research study. The aim of this chapter is to identify and describe the research problem, stemming out from the study of a specific research subject. Based on this, the research question is formulated and expressed, coupled with the unit of analysis, and finally outlining the overall architecture of the given research study.

### **1.1 Research Background**

In much of the recent years the primary criteria that the firms have used for making investment decisions, had been based on some of the Discounted Cash Flow (DCF) evaluation techniques proposed by different academicians, either by using Net Present Value (NPV), Internal Rate of Return (IRR) complemented by Payback Period or Profitability Index. This can be attributed primarily to the premise that under capital rationing, firms are eager to undertake those projects that provide them a higher return on investment with respect to the risks associated with a particular project. As the sole objective of the firm's managers is to create, value for the firm and thereby increasing wealth for the firm's owners i.e. the stockholders Damodaran (2001). However there has been some criticism of the stockholder value creation model, as practised in USA and UK. This compared to the stakeholder model practised in other European countries, which tend to focus more on all the stakeholders involved in a given organization, as discussed by Freeman *et al* (1984 p. 25) *“A stakeholder in any organization is any group or individual who can affect or is affected by the achievement of the organization's objectives”*. Which is further supported by Clarkson in 1995 (as cited by Nwanji & Howell, 2007 p. 15) *“A stakeholder can be a voluntary or involuntary risk bearer. Voluntary stakeholders bear some form of risk because of having invested, some form of capital in the organization - human or finance - something of value. Involuntary stakeholders are placed at risk because of the firm's activities Stakeholder theory is a set of propositions that suggest that management of companies have obligations to some*

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*group of stakeholder*". The author argues that the actions taken by the managers should be analyzed in the light of whether they benefit majority of the firm stakeholders'. The argument focuses more on the decisions taken by the board of directors resulting in the happiness to the majority of its stakeholders' the better it is for the firm and its stakeholder groups. However above traditional financial evaluation techniques of Net Present Value (NPV) and Internal Rate of Return (IRR) enables managers to understand the diverse financial parameters involved while making investment decisions. The diverse financial parameters ranges from the cost of capital of the firm, the risk premium that should be allocated for each project, the amount of time ( $t$ )<sup>1</sup> required to recoup the initial investment ( $CF_0$ )<sup>2</sup>, how the firms can reinvest these streams of cash at the risk free rate (RFR)<sup>3</sup>, the timing of these cash flows across different time periods (Bacon, 1977; Grinyer and Green 2003; Damodaran 2001). These methodologies assist managers in selecting projects, and making investment decisions based on the information provided by them. However, there has been evidence that these methodologies do not take into account all the information concerning the change in the level of risk during the project, other macroeconomic factors like Interest rates, Foreign exchange risk, Sovereign Default risk and therefore are not the absolute criteria for selecting projects based on the financial characteristics of a project Kim and Elsaid (1985).

In addition to the above there has been another group of academics, who have presented their views on the need for more advanced financial evaluation techniques used by organizations, which aims to provide managers a more holistic view while evaluating projects based on financial parameters. The researchers Amram and Kulatilaka (1999), Copeland and Keenan (1998), Dixit and Pindyck (1995), Luehrman (1997, 1998), Trigeorgis (1993) aims to highlight the need that while selecting projects within an organization especially in organizations operating in businesses comprising of a high degree of uncertainty. The financial evaluation tools and techniques used needs to incorporate the value of different options, that are embedded within the project, during the project lifecycle, thereby valuing managerial flexibility, and the value of new information which allow managers to make more informed decisions. This view is predominantly based on the Real Options Valuation technique, wherein *"Real options are options on real assets that can be defined simply as opportunities to respond to the changing circumstances of a project. These opportunities to change consist of rights but not obligations to take some action in the future. Many of these real options occur naturally, while others may be planned and built-in at some extra cost. The role of real options analysis is to quantify how much*

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1  $t$  = Number of Time Periods.

2  $CF_0$  = Initial Investment/Cash Outflow at Time  $t=0$ .

3 RFR= Risk Free Rate is the rate of return on government securities example US Treasury Bills.



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*future opportunities are worth today. Using option pricing models, it is possible to quantify these opportunities and to indicate when these options should be optimally exercised”* Boute *et al* (2004) p. 1716. Therefore, by applying Black-Scholes formula (as shown below) to value a European call option, on a dividend paying share Hull (2000), the value of different real options that are embedded within a project namely (option to abandon, option to defer, option to accelerate) can be derived. However though the researchers have successfully envisaged the diverse benefits that the Real Options Valuation technique offers to the organization, it still hasn’t been much popular, and accepted across a broad range of industries. Damodaran (2005).

**Figure 1: Black & Scholes Formula for valuing a European call option on a dividend paying share**

$$Se^{-\delta t} \{N(d_1)\} - Xe^{-rt} \{N(d_2)\},$$
$$\text{where } d_1 = \{\ln(S/X) + (r - \delta + \sigma^2/2)t\} / \sigma\sqrt{t},$$
$$d_2 = d_1 - \sigma\sqrt{t},$$

Source: Leslie & Michaels, 1997, p. 99

Where (S) is the stock price, (X) Exercise Price of the option, (t) Time to Expiration of the option, (R) is the Risk-free rate of return on a non-risky asset, and ( $\sigma^2$ ) is the variance of the underlying asset, ( $N(d_1)$ ) represents the proportion of shares required to replicate the call option, and ( $N(d_2)$ ) the probability that the call option will be exercised on expiry, ( $\delta$ ) reduces the value of the share to the option holder by the present value of the foregone dividend, and reduces the cost of holding a share by the dividend stream that would be received.

Based on the above arguments in order to embark on the given research study, the researcher needed to identify a business area, which suffice the requirements for the implementation of Real Options Valuation technique. As one of the prerequisites required for evaluating projects based on Real Options Valuation technique, is that there needs to be a high degree of uncertainty involved with the business the organization operates in, since the option becomes more valuable, when the time for expiration of the options is long Kogut and Kulatilaka (1994). This view is further supported by the fact that when using Black & Scholes model for valuing a European call option Hull (2000), one of the variables affecting the value of the call option is the time to expiration of the option. To suffice this requirement the researcher has focused on the pharmaceutical industry in particular firms engaged in new drug development business, to carry out the given case study. The researcher has chosen the given case company X because it operates in new drug development business in the pharmaceutical industry, which is characterize by a high level of risk pertaining to

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both financial, as well as non-financial risk. The financial risk is high because of the significant initial investments required to develop the drug, the non-financial risk addresses to the risk of failure, as the failure risk is significantly higher, and out of approximately 10,000 molecules studied in the beginning, hardly ten makes it to the market (company sources). This coupled with an average duration of 12 years for the projects, makes the given company X, ideal to carry out this research study. The following section will highlight the research purpose for the given study.

### ***1.2 Research Purpose***

In much of the recent times there has been quite a lot of debate upon the miscellaneous financial tools and techniques that are been used by organization for selecting projects. The financial evaluation tools and techniques had been segregated into two wider categories namely the traditional and modern, wherein the former is focused upon the widely practiced techniques of Net Present Value (NPV), Internal Rate of Return (IRR) to name a few. The latter comprises of modern analytical techniques of Real Options Valuation, Decision Tree analysis. This study focuses on the real options valuation technique, though there has been numerous studies from the beginning of 1990's about the potential benefits that Real Options Valuation technique has over traditional ones, but still even after 15 years it hasn't been popular, and used by the businesses. Therefore by means of this study the researcher tries to explore what are the different issues pertaining to the non-implementation of Real Options Valuation technique. In order to carry out this, the researcher tends to conduct a case study within a company X, wherein the researcher initially tries to understand and analyze the existing financial evaluation technique that the given company X uses, and the myriad issues pertaining to the same. Subsequently the researcher tries to analyze the diverse issues that act as an obstacle for the implementation of Real Option Valuation technique in the given company X.

### ***1.3 Research Objectives***

The main objective of the research study is to identify and analyze the diverse issues, namely what are the drawbacks associated with the existing financial evaluation techniques, does the existing technique provides a holistic view to the decision makers while selecting projects. Further are the key decision makers within the given case company X aware of modern financial evaluation techniques like Real Options and the potential benefits it offer to decision makers for selecting projects. If so then what are the reasons, it has not been used in the given case company X for selecting projects.

The main research objective has been further broken into two minor objectives. The minor research objectives are:

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1. To identify and analyze the issues namely the drawbacks associated with the existing financial tools and techniques, does it provides the decision makers deep insights about the projects, during the selection phase pertaining to the existing financial evaluation tools and techniques the given company X, uses to select projects.
2. To identify and examine the varying issues pertaining to the implementation of Real Options Valuation technique in case company X. The issues that are been investigated are predominantly focused on; are the key decision makers aware of advanced financial evaluation techniques like Real Options and the advantages it offers on the existing ones. If so what are the reasons, of it not been implemented in the given company X for selecting projects.

Therefore based on the above mentioned research objective and following a structured scientifically proven research methodology approach, the given study will contribute towards identifying various obstacles associated with the implementation of Real Options Valuation technique for selecting projects. Further as the researcher intends to carry out the study in a case company X in the pharmaceutical industry. It will help the practitioners in not only analyzing a number of obstacles associated with its implementation, but also indicate ways to overcome them in order to reap the perceived benefits that Real Options Valuation technique offers for selecting projects. The following section discusses about the research question for the given study, the question stems out from the research objectives discussed in this section.

#### ***1.4 Research Question***

In order to achieve the above mentioned objectives, the researcher has defined one research question:

***“What are the roadblocks associated with the implementation of Real Options Valuation technique at company X in Sweden?”***

As discussed previously the study aims to identify the different issues associated with the non-implementation of Real Options Valuation technique, even though there has been several studies, that have highlighted the importance of valuing options that are embedded within the project. The unit of analysis for the given research study will be the obstacles associated with the implementation of Real Options Valuation technique in the given company X.

The case study has been carried out with an aim of helping the given case company X, to make informed decisions while selecting project based on financial parameters, specifically capturing the value of new information that managers receive during the project lifecycle. Furthermore, the study is further expected to contribute

among practitioners, and academic fraternity about the myriad of issues that discourage organizations from adopting Real Options Valuation technique for selecting projects. The following section describes the global pharmaceutical industry, a brief overview of company X, and the new drug development process, within the given company X.

### ***1.5 Global Pharmaceutical Industry:***

The global pharmaceutical industry is fragmented into two business domains, one that focuses on new drug discoveries, firms like Glaxo SmithKline plc. (UK), Pfizer Inc. (USA), AstraZeneca plc. (UK), Hoffman La Roche AG. (Swiss) and Novartis AG. (Swiss). The business model of these firms focuses on the discovery of new molecules, which leads to the development of new drugs, to treat newer or existing diseases, the firms operate in a capital intensive environment, since from the discovery of a new molecule, to getting the drug to the market, requires substantial financial commitment. The firms operating in this industry have extensive R&D budgets, because of their heavy reliance on the discovery of new molecules.

The other kinds of firms that operate in this industry are the firms that manufacture 'Generic' version of the existing drugs, once the 'patent' of the existing drugs expire. The market gets flooded by the same drug manufactured by different generic manufacturers, at a very low cost with respect to the one offered by the original patent holding firm. The business model of these firms revolve around, taking the existing patent molecule, undertaking efficacy studies and submitting the results with the necessary regulatory bodies, which generally is the US FDA (United States Food & Drug Administration), once this is done the firms, can launch the generic version of the patent drug, once the patent of the existing drug is expired. These firms can offer existing drugs; at reduced costs because the cost of R&D is negligible, when compared with the R&D spend of new drug development firms. The firms that operate in this business domain are Ranbaxy Pharmaceutical Ltd. (INDIA), Dr. Reddy Pharmaceutical Ltd. (INDIA), Teva Pharmaceuticals (ISRAEL), Abrika Inc. (USA).

### ***1.6 Company Overview***

The given company X was formed in 1999 by the merger of Swedish-based pharmaceutical company and a UK-based pharmaceutical Group. Company X has a strong presence in the US and retains a significant presence in Sweden as a legacy of the prior merger entity. The company is headquartered in London and employs more than 67,000 people worldwide. The company recorded revenues of \$29,559 million during the financial year (FY) ended December 2007. The operating profit of the company was \$8,094 million during FY2007, a decrease of 1.5% over 2006. The net profit was \$5,627 million in FY2007, a decrease of 7.2% over 2006.

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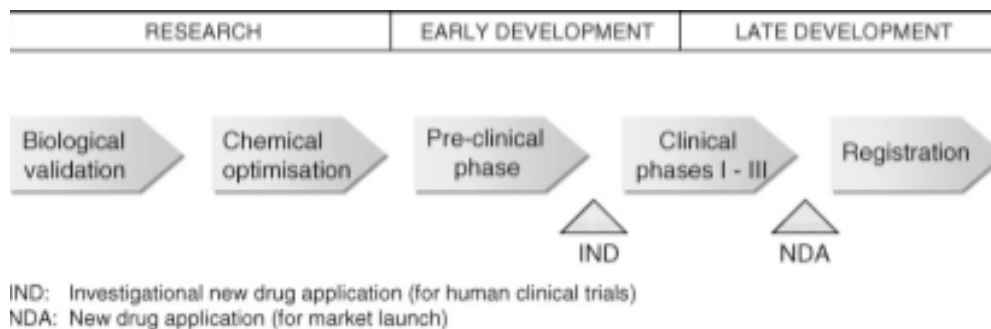
Company X is one of the leading global healthcare companies engaged in research, development, manufacturing and marketing of prescription pharmaceuticals. The company is also a supplier for healthcare services. It is a leader in gastrointestinal, cardiovascular, neuroscience, respiratory, oncology and infection product sales. However, blockbuster drugs' exposure to generic competition could negatively impact Company X's future performance beyond 2012.

In the context of the given company X, as discussed above since the company operates in the business of new drug development, within the pharmaceutical industry. The following section explains the process of new drug development.

### **1.6.1 New Drug Development Process at given Company X**

The new drug development process at the given company X starts from a given pool of 10,000 molecules. For a given therapy area pre-clinical testing starts at this stage for analyzing the pharmacology, and toxicology of the compounds out of the given pool of molecules, 5-10 molecules are passed on to the next stage which have passed the pharmacologic screening, pharmacodynamics, pharmacokinetics, toxicokinetics, acute toxicity, subchronic toxicity, and genotoxicity. Once this is completed an Investigational New Drug (IND) application is made, further to this clinical trials are carried out which include the clinical Phase-1 (Safety), Phase-2 (Efficacy), and Phase-3 (Safety & Efficacy). As illustrated in the following figure:

**Figure 2: The Pharmaceutical R&D Process**



Source: Mohr *et al* (in press)

In the pre-clinical phase the identified compound is first tested on animals (in vivo), and test tube (in vitro) experiments are conducted to ascertain the effects, and the possible reactions exhibited by the subject<sup>4</sup>. Further to this once a Identified New Drug (IND) application is made, clinical trials are conducted which in phase-1 include first time testing on human beings in a small subject of (15-20), healthy volunteers and the effects of the new drug is recorded. Nevertheless, in this phase the emphasis is more on the safety of the new molecule, once this is carried out, phase-2 clinical trials

<sup>4</sup> Subject in pharmaceutical industry refers to the sample population used to carry out clinical trials.

in which the size of the subject is increased from (20-300) healthy individuals. The emphasis here is more on the efficacy of the drug, which means that the drug works as it was planned in the previous stages, and there are no toxic side effects involved with it. As the clinical trials progress the number of molecules are reduced from the initial 10 to 5 by the end of phase-2 studies, once the phase-2 studies are completed. The molecule then enter into phase-3 clinical trials, in which the size of the subject is increased from (300-3000) based on the molecule, and the disease area studied, however in the phase-3 clinical trials, the trials are conducted across multiple centres, and across geographical locations to ascertain the degree to which the new drug is effective. Once this is complete, the company files for New Drug Application (NDA) with the relevant regulatory body FDA (USA), EMEA (EU), TGA (Australia). Once the application has been made the regulators reviews the data, and information provided by the respective company with respect to the New Drug Application, and the company is granted the permission to market the new drug. Once the company receives the permission, it can market the new drug in the given markets, which are under the purview of the given regulators. The post launch clinical trials or post marketing surveillance trials aims to administer any long term adverse effects that the new drug might exhibit, and also a new disease that the new drug can treat, leading to the discovery of a new market. As the company at the time of making (IND) application explicitly mentions the therapy area/disease, which is treated by means of specific compound that has been investigated.

### ***1.7 Outline of the study***

The primary purpose of the study is to answer the research question and achieve the research objective as discussed previously. In order to do so in this chapter the role of financial evaluation techniques is presented. Further based on these the research objectives were defined, which leads to the research question and the unit of analysis for the study. The next chapter provides the literature review wherein the theoretical background of the study will be discussed, and introduces the different financial tools and techniques, that address the underlying research question. Based on this the knowledge gap will be identified, which will be the focus of the given study. The next chapter will be of the research methodology, which highlights the underlying research philosophy and the approach associated with the given study. The research method used, and the tools used to collect data, and subsequent data analysis technique used. Finally the issues related to validity and reliability of the study will be highlighted. The data analysis chapter follows the research methodology chapter, wherein the data analysis technique for the given study, coupled with the analysis of data gathered by means of semi structured interviews will be discussed. This is followed by the discussion chapter where based on the findings from the previous chapter of data analysis, more detailed analysis will be presented. Finally the study

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ends with the conclusion chapter where findings of the given study will be briefly summarized, along with the implications of the given research study for academicians and practitioners. It will also shed light on the strength and weakness of the given study, and finally providing suggestions for the scope of further study in future.

## **Chapter 2. Literature Review**

### **2.1 Introduction:**

The purpose of this chapter is to build a general understanding around the research area. Firstly, the process on how the appropriate literature was retrieved will be explained, followed by the examination of heterogeneous financial tools and techniques used by organization, while evaluating projects. Based on that the literature review has been divided namely into two categories traditional Discounted Cash Flow (DCF) based financial evaluation techniques, and modern financial evaluation technique of Real Options Valuation. Based on this the knowledge gap for the given research study is defined. The following section explains the search process for retrieving the appropriate literature for the given study.

#### **2.1.1 Search Process**

In order to retrieve the related articles and publications for the given study, literature on the relevant topic was first searched at <http://scholar.google.com>. The following key words were used (Real Options, Project Finance, Project Evaluation, Options Valuation, Net Present Value and Internal Rate of Return) both in the above mentioned search engine, and in a variety of academic (Journal of Business Finance and Accounting, Harvard business review, International journal of project management) and practitioner's (The Mckinsey Quarterly) journals by using EBSCO-HOST and JSTOR databases, which were accessed from UMEÅ and Heriot-Watt universities.

Once the relevant articles and studies have been retrieved the researcher has further segregated them into two categories:

- Traditional Discounted Cash Flow (DCF) based Financial Evaluation Techniques.
- Modern Financial Evaluation technique using Real Options Valuation



## ***2.2 Traditional Discounted Cash Flow (DCF) based Financial Evaluation Techniques***

As discussed previously, this section reviews the traditional discounted cash flow (DCF) methodologies that are used for selecting the projects; primarily the Net Present Value (NPV), Internal Rate of Return (IRR) and the Payback period (PB), and Profitability Index (PI) Damodaran (2001). The NPV model is based on the concept of Time Value of Money, which explains that with the passage of time, the value of money depreciates or in other words, what is the worth of 1\$ today compared to 1\$ a year later. Since 1\$ today can be spent instantaneously in order to forego the opportunity of consuming the same 1\$ today, the investor should be compensated with some return, which can be in the form of interest. However the interest offered should take into account the expected inflation, therefore the rate of return offered on 1\$ taking into account the expected inflation gives the nominal rate of return, and the rate of return excluding the expected inflation is the real rate of return. Damodaran (2001).

NPV represents the present value of the future cash inflows ( $CF_t$ ) over ( $t$ ) time periods, and ( $r$ ) is the one period discount rate that applies to period ( $t$ ), which takes into account the firm's cost of capital and the risk premium associated with the given project, and ( $n$ ) is the life of the project.

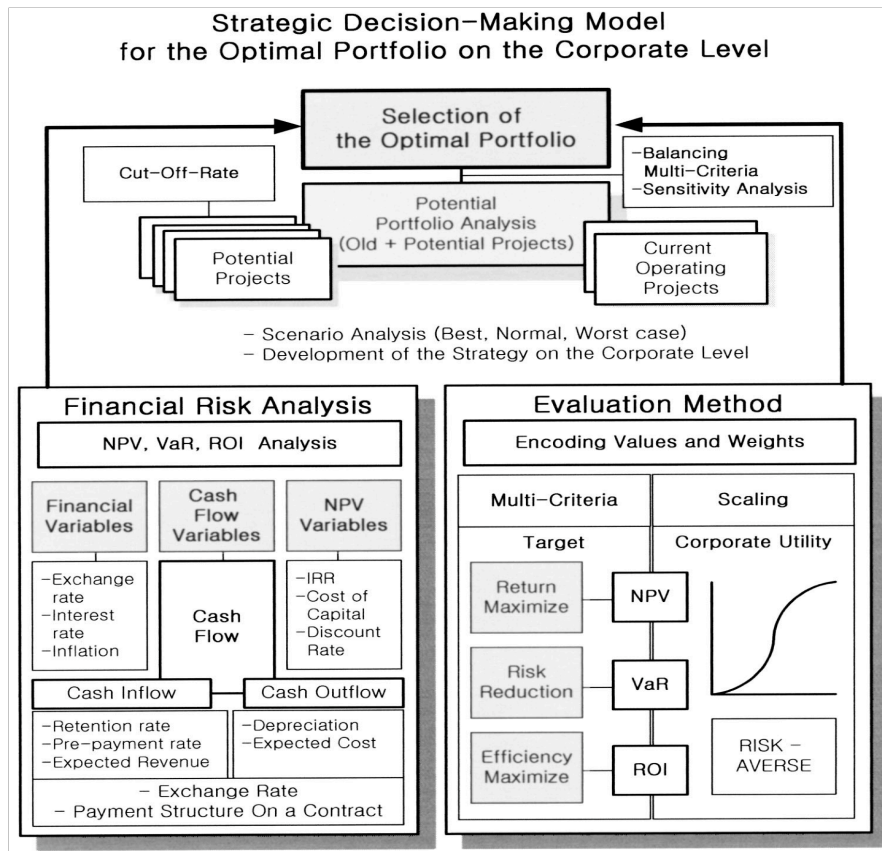
### **Net Present Value (NPV) of a project**

$$CF_1/(1+r^1) + CF_2/(1+r^1)(1+r^2) + \dots + CF_n/(1+r^1)(1+r^2)(1+r^3) \dots (1+r^n) - \text{Initial Investment}(CF_0)$$

If the NPV of the project is positive, then its been given a “GO” signal, and the firm undertakes the project. However, if the NPV is negative, the project is discarded with the assumption that the capital available to the firm is not rationed, and thus firm can undertake all the projects with a positive NPV. This view is predominantly based on the premise that positive NPV projects create value for the firm, and negative NPV do not add any value to the firm, and hence should not be taken by the firm. The multiple criteria based integrated portfolio model proposed by Han *et al* (2004) has further supported this view, wherein the authors has used the NPV, Value at Risk (VaR) and Return on Investment (ROI), as the key variables to ascertain the financial risks of the project. Wherein NPV focuses on maximizing return for the firm by undertaking projects with a higher NPV, whereas VaR focuses on the risk reduction technique that the firm uses in order to minimize the riskiness of the project portfolio, and ROI highlights the efficiency of the assets that the firm uses in order to undertake different projects.

## *-Obstacles Involved With Real Options Valuation Technique-*

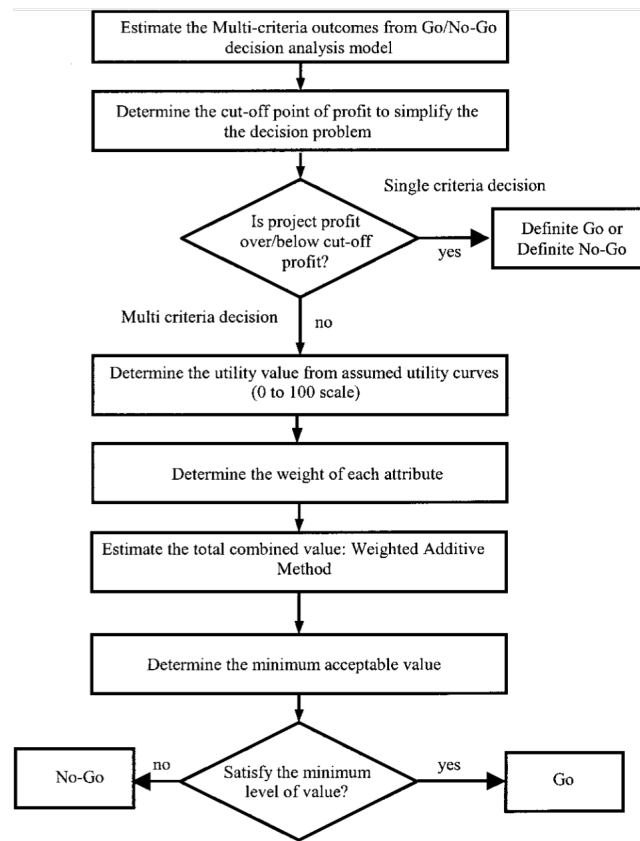
**Figure 3: Multiple Criteria Based Integrated Portfolio Model**



Source: Han & Diekmann, 2004, p. 349

However, Han and Diekmann (2001) Go/No-go decision process model argues about the traditional financial evaluation of projects based on NPV. Though the given model involves multiple criteria, and is based on a probabilistic approach wherein weights are attached to different criteria's, and a weighted average is taken to ascertain only those projects that will be undertaken, which have a value above than the minimum accepted value, derived in the beginning of the project. Although it allows a speedy evaluation of projects, it fails to address all the risk factors involved with the project, which can arise in the project life cycle. The traditional methods fail to address the uncertainties involved with long term systems, since they doesn't take into account the risk based contingencies involved in the evaluation of strategic alternatives.

**Figure 4: Go/No-go Decision Process Model**



Source: Han & Diekmann, 2001 p. 768

The above argument has been further strengthened by Bacon (1977) who argue that in case of mutually exclusive investment opportunities, how NPV and IRR give conflicting rankings, based on the timing of the cash flows. The author further states that in case of capital rationing, the discount rate used in calculating NPV should consider the internal investment opportunities in the firm. However, in case the investment is not rationed then the discount rate should reflect the firm's cost of capital. This has been further supported by Antle *et al* (1999) who had demonstrated how NPV is useful while selecting mutually exclusive projects, i.e. under capital rationing, when firm cannot undertake all the projects with positive NPV's, due to lack of funds.

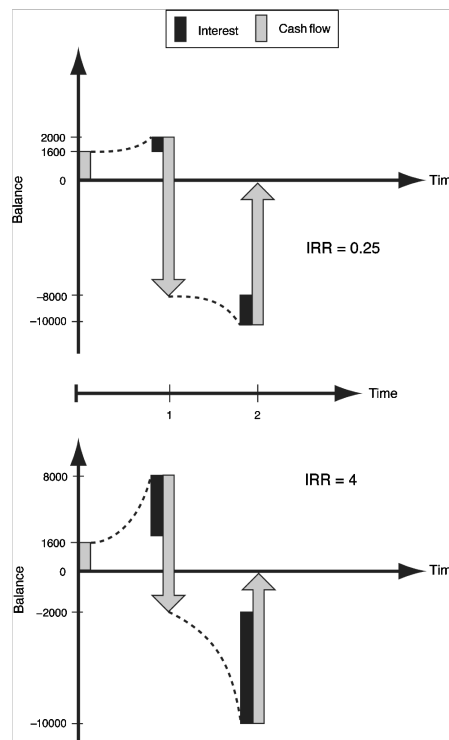
In addition to above Wachowicz and Shrieves (2001) has demonstrated how Free Cash Flow (FCF) and Economic Value Added (EVA) can be used for valuing future investment opportunities available with the firm, independently of the NPV method. The authors have successfully demonstrated that the results derived from the EVA and FCF techniques are identical to the NPV evaluation method. Nevertheless, the practical applicability of both the techniques remains questionable because of the complex accounting adjustments needed to do the evaluation, especially in light of the

### ***-Obstacles Involved With Real Options Valuation Technique-***

existing NPV technique. This has been further strengthened by Hartman (2000) who have demonstrated how NPV and Market Value Added (MVA) technique, which is the present value of a series of Economic Value Added (EVA) values, provide identical results. The author argues in support of the MVA technique based on the rationale that it provides insights on the tax effect, since MVA technique takes into consideration the after-tax analysis. It considers project under the implicit assumption that capital is not rationed, and thereby takes into account the firm's cost of capital, however the applicability of MVA under capital rationing when the discount rate used is the firm's reinvestment rate, still remains questionable.

Lately another criteria used for project selection is based on Internal Rate of Return (IRR) for selecting projects which has been discussed by Johnstone (2008) p. 78 where IRR is defined as *"A discount rate on a future cash flow of streams, at which the Net Present Value is zero"*. The author discusses that the IRR is the rate at which the cash flows generated from the project can be reinvested at the same rate in other opportunities and will provide the same return, the author shows mathematically how in case of uneven cash flows there can be multiple IRR's. The following figure demonstrates how the timing of cash flows generated by a given project, can significantly affect the resulting IRR's.

**Figure 5: Comparative account balances under an internal rate of return (IRR's) 25 percent and 400 percent.**

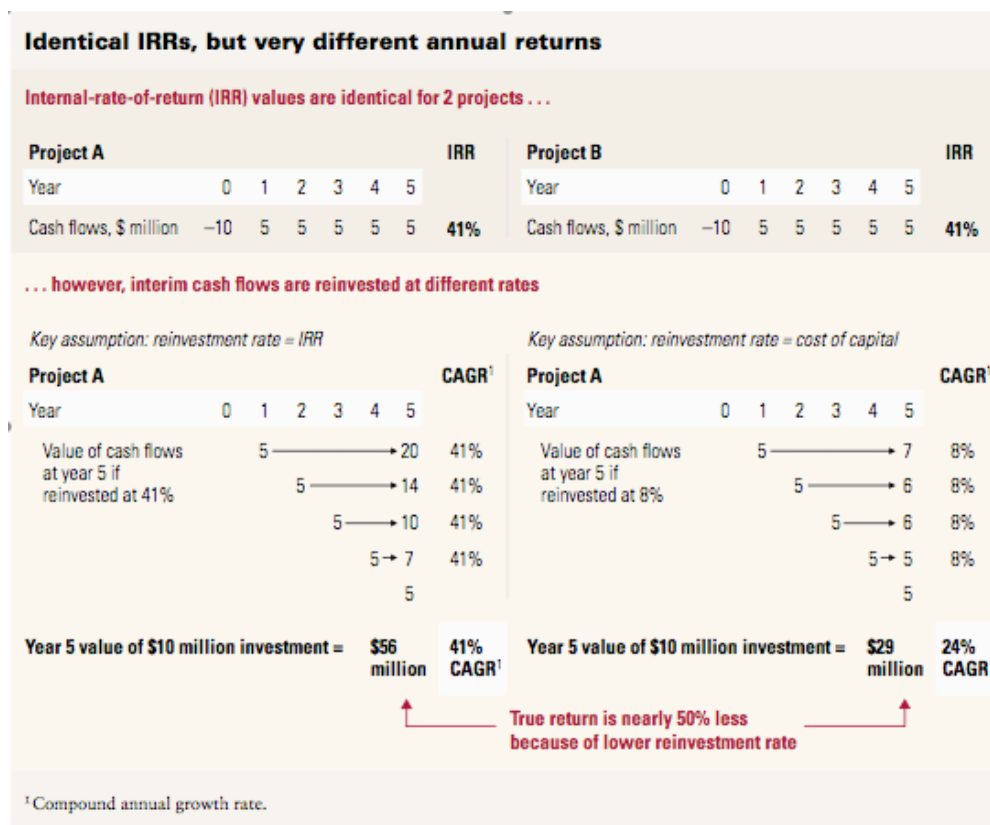


Source: Johnstone, 2008, p. 83

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However according to Zhang (2005) there are some issues that are not been addressed by the internal rate of return criteria. The author identifies that in case of mutually exclusive projects i.e. when the firm can undertake only one project from a given set of projects, IRR provides conflicting rankings versus NPV, since the project with higher IRR, can probably have a potentially lower NPV. This coupled with the problem associated with multiple real IRR in the same project, attributed to the multiple changes in the sign of cash flows, results in making incorrect investment decisions, when using both IRR, and NPV for selecting projects based on financial parameters. The evidence provided by Kelleher and MacCormack (2005) has further strengthened the author's argument who argues that managers often believe that internal rate of return is the annual equivalent return on the given investment. Whereas in reality it is the annual return on the project, when there are no interim cash flows or when those cash flows can be reinvested at the actual IRR. The following figure demonstrates how for the identical project with identical cash flows, and time periods, there are different returns. This is primarily because IRR takes into account the cost of capital of the firm, and the subsequent riskiness associated with the project. However, the cash flows from the given project cannot be reinvested back at the given IRR of the project, but at the cost of capital of the firm.

**Figure 6: Different Annual Returns with Identical Internal Rate of Returns (IRR's)**



Source: Kelleher & MacCormack, 2005, p. 72

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Lately Keane (2005) has further extended the key assumption behind IRR, that reinvestment can be made at the internal rate of return, in the event of capital rationing as irrational. Because in case of capital rationing the firm cannot undertake all the projects, and cash receipts from current projects are important to finance additional projects, which otherwise would have been rejected for lack of funds. Since IRR measures the maximum cost of capital that a project can sustain, irrespective of the investment opportunities for the cash flows; and the funds required to finance additional projects are independent of the IRR's of the present projects. It is therefore irrational to assume that cash flows from current projects can be reinvested at the given IRR of the project.

In contrast to the above Grinyer, and Green (2003) have discussed about the applicability of payback period (PB)<sup>5</sup> to act as a surrogate to NPV and Profitability Index (PI)<sup>6</sup> criteria for selecting projects. The authors' discussion is based on a certain set of assumptions, which include standardized pattern of cash flows, defined risk classes, and asymmetrical information. Under the given set of assumptions, use of PB will encourage risk adverse managers to undertake projects that are more positive. However (Damodaran, 2001) has contradicted this approach as he argues that PB should be used as a secondary approach to make investment decisions since the PB criteria ignores the cash flows after the initial investment, and does not takes into consideration the cash flows over the projects life. Further PB is successful when there is a large up-front investment, it fails to address projects in which there is no initial investment, or when there are a series of positive and negative cash flows.

The given section has focused about the various traditional financial evaluation techniques that are been used by firms in order to select projects. The section has further examined the different issues involved with different financial evaluation techniques namely Net Present Value (NPV), Internal Rate of Return (IRR), PayBack period (PB), and Profitability Index (PI). In response to the arguments presented above it can be inferred that Net Present Value is the most preferred traditional financial evaluation technique used for selecting projects. The following section will examine the NPV technique in detail, and will throw light on modern financial evaluation techniques.

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<sup>5</sup> Payback Period (PB) refers to the number of time periods required for the cash flow generated by the project to cover the initial investment. (Damodaran, 2001)

<sup>6</sup> Profitability Index (PI) refers to dividing the NPV of the project by the initial investment in the project. (Damodaran, 2001)

### **2.3. Modern Financial Evaluation technique using Real Options Valuation**

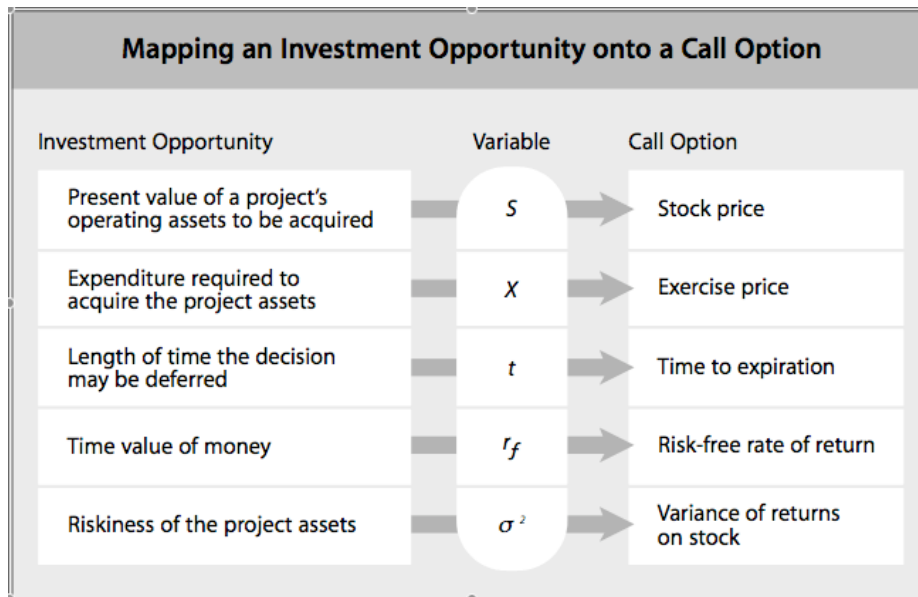
As discussed previously NPV is the most favourable criteria for making investment decisions, practised by managers. However, there have been some critiques regarding the potential drawbacks it poses, particularly its ignorance for managerial flexibility while making investment decisions. According to Trigeorgis (1993) the traditional DCF techniques and NPV rule are inadequate for capital budgeting process because they fail to take into account management's flexibility to revise their decisions in response to unexpected market developments. The author further argues that traditional NPV criteria considers implicit assumptions about the future stream of cash flows and ignores the uncertainty and competitive interactions that firms encounter in the market place. As new information arrives management can modify previous investment decisions, in order to take leverage of the favourable opportunities, or mitigate losses. The author proposes that while making investment decisions, the managers have an option<sup>7</sup> to defer, expand, contract, abandon or otherwise alter a project at different stages during its useful operating life. The NPV criterion fails to take into account the value of these options, and provides information based on the future stream of cash flows. To further support this view, the author demonstrates how value of an investment deal may not depend solely on the amount, timing and operating risk of its measurable cash flows. The future operating outcomes of a project can actually be impacted by future decisions, depending on the inherent operating and financial options embedded within the project. This has been further supported by several authors (Luehrman, 1998; Yeo & Qiu, 2003) who have mapped the investment opportunity of a corporation with respect to a project into a European call option<sup>8</sup>, and have mathematically calculated the value of a European call option, embedded in a project using the Black & Scholes model, Hull (2000). The authors by means of substituting the project variables, with that of the variable required for calculating the value of a European call options, have demonstrated how the value of options embedded within a project can be derived by using Black & Scholes model, Hull (2000) to calculate the price for a European call option, on a dividend paying share.

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<sup>7</sup> An option is the right, but not the obligation, to take an action in the future. Amram & Kulatilaka, (1999)

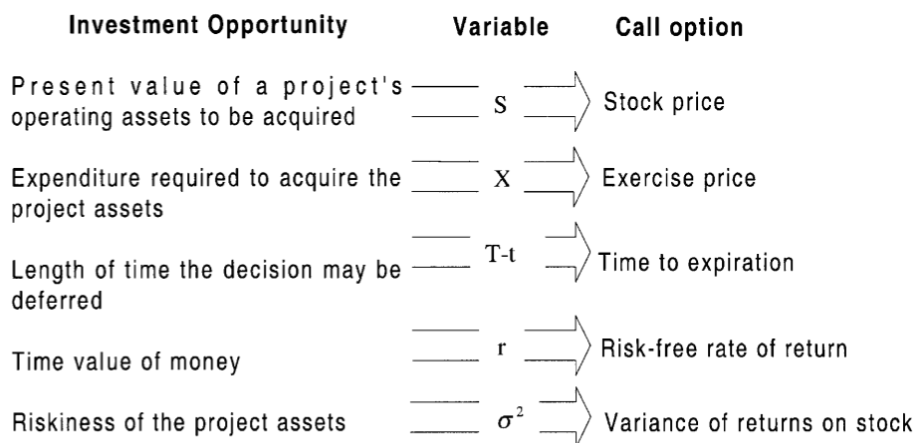
<sup>8</sup> A European call option gives the option holder the right to buy an underlying asset by a certain date for a certain price, the price is known as Exercise Price/Strike Price. It can only be exercised on the expiration date. Hull, (2000)

**Figure 7: Mapping Investment Opportunity on a European Call Option**



Source: Luehrman, 1998, p. 4

**Figure 8: Linking Investment Opportunities of a Project onto a European Call Option**



Source: Yeo & Qiu, 2003, p. 246

Leslie and Michaels (1997) have compared the six levers of financial and real options and further supported the given model and demonstrated how the variables of Black & Scholes model while valuing a European call option, for financial option, can be mapped in case of projects. The author's highlights how an increase in uncertainty of expected cash flows, period the opportunity i.e. the option is valid, present value of expected cash flows, and the yield on a riskless security can increase the value of the option. Further the authors demonstrate how present value of fixed costs and value

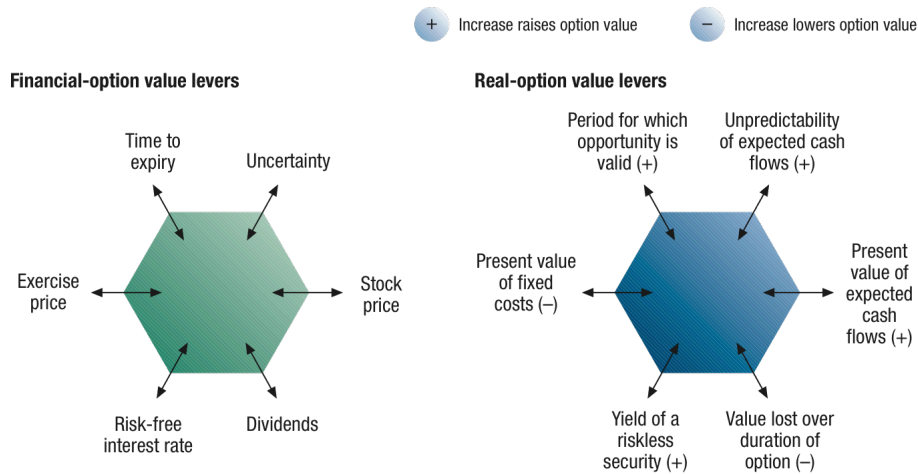


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lost over the duration of option can decrease the value of the option embedded within the project.

**Figure 9: Levers of Financial and Real Options**

### **The six levers of financial and real options**

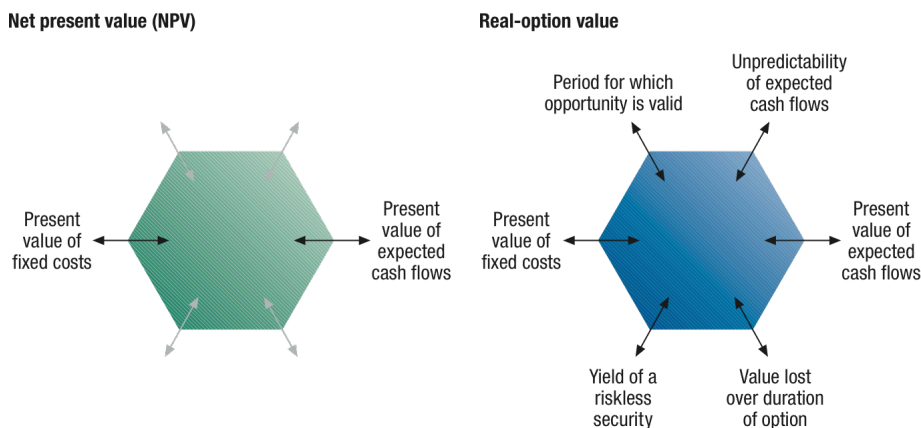


Source: Leslie, & Michaels, 1997, p. 100

In addition to the above Leslie and Michaels (1997) have further compared the valuation methodologies used in calculating NPV and Real Options, and the information gaps that DCF based NPV techniques fail to address. The authors further state that NPV criteria provide a static measure, making one-time decisions, whereas real options strategies take into account their response to uncertainty. The authors have buttressed their claim by providing empirical evidence of Real Options applicability by British Petroleum during 1990's.

**Figure 10: Comparison Between Net Present Value and Real Options Valuation**

### **Comparison of valuation methodologies**

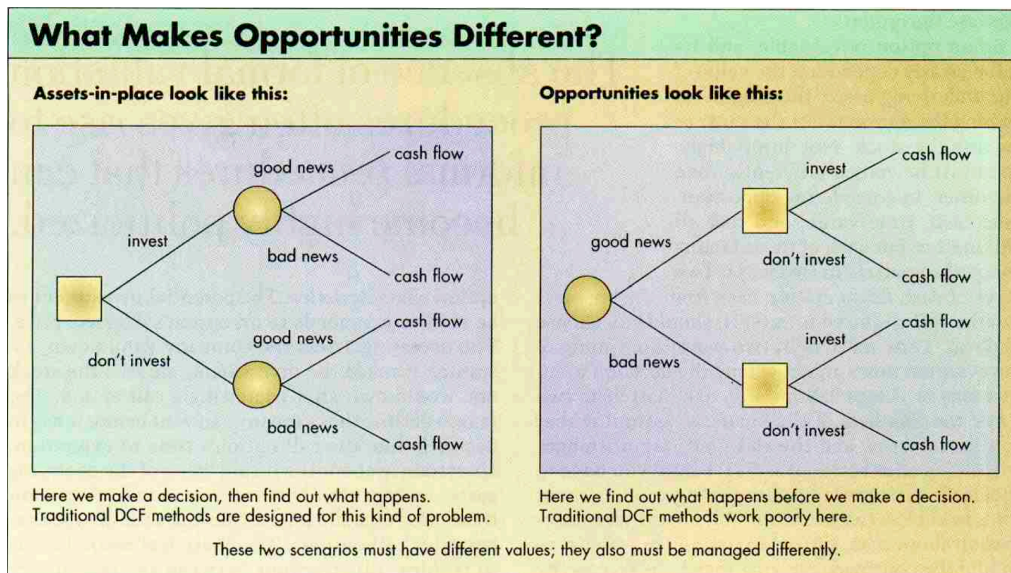


Source: Leslie & Michaels, 1997, p. 102

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The above model is further supported by Luehrman (1997) model of “*what makes opportunities different*”, which demonstrates how Real Options decision-making approach is better, than the DCF based NPV technique. In the given model the author highlights how in case of NPV the assets in place look like and as more information arrives in the form of good or bad news, it affects the cash flows. Since it is based more on a predetermined stream of cash flows determined in the beginning of the project, whereas on the other hand the author highlights how opportunities look like, wherein the decisions are made based as new information arrives, again in the form of good news or bad news. The author in the end concludes that since in both the scenarios, where one focuses on the assets while other focuses on the opportunities, the outcomes are quite distinct and implies that they need to be managed differently.

**Figure 11: Difference between Assets-in-place and Opportunities**



Source: Luehrman, 1997, p. 138

The above view of Luehrman (1997) has been further strengthened by the comparison provided by Copeland and Keenan (1998), wherein the authors have made a comparison between alternative decision-making tools employed by managers for making investment decisions, based on four criteria's namely Cash Flows, Risk Adjustment, Multiple time periods and managerial flexibility. Herein the authors demonstrate though NPV technique is cash flows based, takes into account the degree of risk associated with the project, and can be applied across multiple time period, but it doesn't takes into account managerial flexibility. This is captured by the Real Options Valuation technique, which in addition to capturing the value of managerial flexibility also takes into account the other three parameters.

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**Figure 12: Classification between Real Options Valuation, NPV, Decision Trees, Economic Profit and Earnings Growth Models**

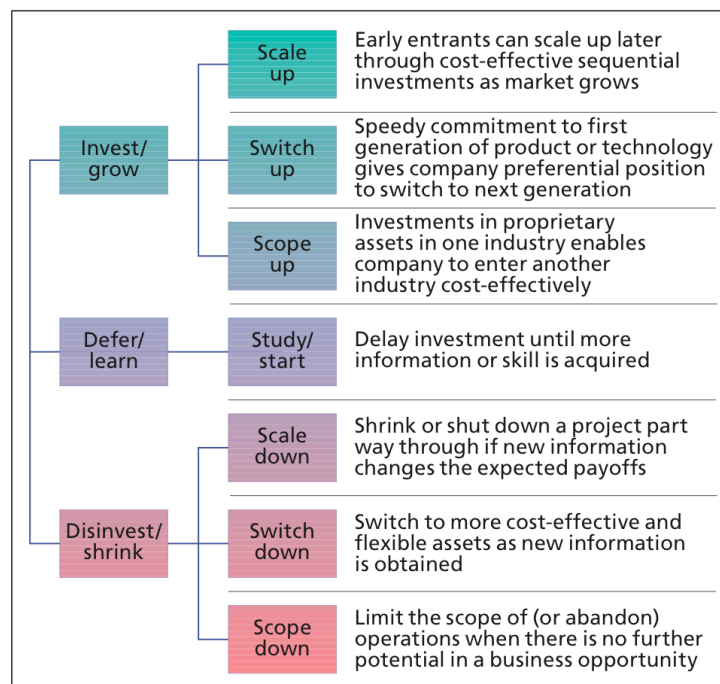
### Key criteria for decision-making tools

	Cashflow based	Risk adjusted	Multi-period	Captures flexibility
<b>Real option value</b>	✓	✓	✓	✓
<b>NPV/DCF</b>	✓	✓	✓	✗
<b>Decision trees</b>	✓	✗	✓	✓
<b>Economic profit</b>	✓	✓	✗	✗
<b>Earnings growth</b>	✗	✗	✗	✗

Source: Copeland & Keenan, 1998, p. 45

The authors had further proposed a 7S framework classifying individual real options into growth, deferral/learning and abandonment options.

**Figure 13: 7S Framework for classifying growth, deferral and abandonment options**



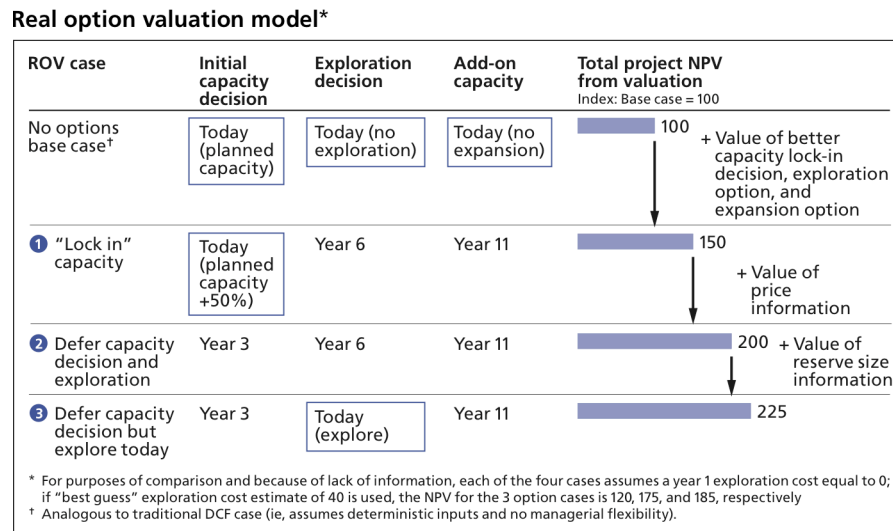
Source: Copeland & Keenan, 1998, p. 48

The authors Copeland and Keenan (1998) further states that traditional decision-making tools like NPV, EVA, and Earnings Per Share tend to neglect the value of changing a decision, once new information's is made available, since making irreversible investment decisions is risky. Real Options capture that value of flexibility, and enables managers to make investment decisions in uncertainty; this is

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further supported by Coy (1999) and Trigeorgis (2005). Lately in a subsequent article the authors have used a case study on natural gas field, to demonstrate the Real Option valuation model

**Figure 14: Graphical Representation of Real Options Valuation technique for evaluating natural gas field**



Source: Copeland & Keenan, 1998, p. 138

Several authors have supported the above notion, and have further identified four conditions for real options to be valuable namely - uncertainty, opportunity, time dependence and discretion. (Kogut & Kulatilaka, 1994; Dixit & Pindyck, 1995; Barnett, 2005) The authors have further strengthened their argument by assessing the value of real options in light of the organisational capabilities.

Lately, several authors have discussed the applicability of Real Options in strategic planning and project portfolio management (Huchzermeier & Loch, 2001; Kogut & Kulatilaka, 2001; Copeland & Howe, 2002; Boute *et al* 2004; Janney & Dess, 2004; Smit & Trigeorgis, 2006). Further, Helmchen (2007) has discussed the evaluation of real options in strategic management, where he has classified the real options and the managerial flexibility they offer in decision making. The author discusses the different types of options that are embedded within a project, and the flexibility they offer to managers while making investment decisions, during different time points of the project lifecycle.

**Figure 15: Variety of Real Option and Corresponding Flexibility**

Type of Real Option	Expression of the Flexibility
The option to defer	The option to defer, or to wait, derives its value from reducing uncertainty granted by the ability to wait until more information has arrived
The option to abandon	The possibility of shutting down an unprofitable project
The option to switch	The flexibility to change the nature of the input or output, or modus operandi (to use substitutes)
The option to contract /expand	The capability to alter the capacity depending on market conditions (low/high demand, intensity of competition)
The option to growth	To create infrastructure and opportunities for future expansion
The option to stage/ compound option	To break up investment into incremental conditional steps

Source: Helmchen, 2007, p. 390

In another development Childs *et al* (1998) have mathematically demonstrated how real options model can be applied in multiple projects that can be developed in parallel or in sequence. However, in contrast to Childs *et al* (1998) work, Kogut and Kulatilaka (2001) and Zardkoohi (2004) have further strengthened the applicability of real options from a social and psychological perspective in the context of organization theory. However, this has been argued by the attention based view of the real options reasoning proposed by Barnett (2005) and (2008) where the author has discussed the managers' decision making ability in a real options valuation technique. Further Perlitz *et al* (1999) have proposed a Real Options Valuation model to evaluate the R&D investments, and the potential upside benefits, that the Real Options Valuation technique provides over the NPV criterion. Reyck *et al* (2005) have further validated their argument by providing empirical evidence of applicability of real options in Information Technology projects, followed by the empirical results from a survey carried on Real Options analysis for pharmaceutical R&D project valuation by Hartmann and Hassan (2006).

In light of the above arguments, it can be assumed that real options provide the right kind of technique for managers to make investment decisions. However, since its popularity from early 1990's there has not been significant evidence to support that managers have adopted the real options valuation technique across a wide range of industries and geographical locations. There has been some empirical evidence to support the fact that real options create more value for the firm, compared to the traditional DCF based techniques for making investment decisions. As it accounts for managerial flexibility and capture the uncertainty associated with the project, it thereby accrues additional value to the embedded options in the project, which it possess Reyck *et al* (2005).

## ***2.4 Knowledge Gap and Summary***

The present real options valuation technique has addressed the benefits that management can obtain, to assess the allocation of capital resources in today's complex and demanding environment for capital. It therefore enables managers to make informed investment decisions; but since its inception in early 1990's Real Options Valuation technique has not been popular across businesses around the globe. This leads the researcher to examine what are the miscellaneous issues involved with the implementation of Real Options Valuation technique, though there has been little evidence about a variety of practical issues incorporated in the implementation of real options valuation technique across businesses. Lander and Pinches (1998) have identified three issues involved in the practical implementation of the real options technique. Firstly, poor understanding of the model by corporate managers and practitioners, secondly violation of modelling assumptions in practical real option application, and thirdly additional assumptions required for mathematical tractability, limit the scope of applicability.

This study extends prior research on how managers make investment decisions based on financial parameters, and what are the disparate drawbacks included in the traditional methodologies in a general business environment. Further, how these drawbacks can be addressed and thereby allowing managers to make more informed investment decisions while selecting projects. The study's focus is on what are the different issues involved with the implementation of Real Options Valuation technique. The researcher intends to examine this within the context of a given case company X. Based on the literature review the researcher observed that there has been a dearth of study in the area of what are the miscellaneous issues associated with the non-implementation of Real Options Valuation technique in businesses. Though several studies showcase that Real Options do capture value of managerial flexibility and takes into the value of new information, which allows managers to make informed decisions, and providing a more holistic view of the project.

In this regard, the researcher has observed that a research study in a given case company X in Sweden, on what are the obstacles involved, with the implementation of Real Options Valuation technique will contribute towards the knowledge gap. Since as discussed by Trigerorgis, (1993), Kogut and Kulatilaka (1994), Dixit and Pindyck (1995) Real Options Valuation technique takes into account the value of new information, as it arrives at different milestones during the project life cycle. It therefore provides managers to value different options at different milestones embedded within the project and thereby providing deeper insights to the decision makers for selecting projects based on financial parameters.

## ***2.5 Justification to Continue***

Lander and Pinches (1998) identified three challenges pertaining to the implementation of Real Options Valuation technique across businesses, namely ignorance among practitioners about Real Options Valuation technique, additional assumptions often violated while applying Real Options framework, and finally additional assumptions required for mathematical tractability. However, as there work was predominantly based on existing theoretical frameworks, it would be interesting to analyze how these challenges apply in the context of the given case company X in Sweden. In order to undertake the given study the researcher has drawn the following propositions:

- What are the issues associated with the existing financial evaluation techniques practised within the case company X for selecting projects, concerning project evaluation and the degree of risk associated with the project.
- What are the different obstacles pertaining to the implementation of Real Options Valuation technique for selecting projects within the given case company X.

Therefore summarizing all the above, in this chapter the researcher discussed a variety of financial evaluation techniques that are used by organizations while selecting projects. The researcher further segregated the financial evaluation techniques into traditional and modern, wherein the traditional focuses on the existing techniques of Net Present Value (NPV), Internal Rate of Return (IRR) etc. whereas the modern financial technique focuses on the Real Options Valuation technique. The researcher further by means of several research studies highlighted a variety of issues associated with the traditional financial evaluation techniques, and the benefits that modern evaluation techniques, pose on the traditional one. In pursuit to understand the diverse challenges involved with the non-implementation of Real Options Valuation techniques in businesses, the researcher undertakes a qualitative study in a given case company X in Sweden. The following chapter provides a more detailed description of the methodology used for the abovementioned study.

## **Chapter 3 - Research Methodology**

In the previous chapter the overview of the given research, study and literature pertaining to financial evaluation techniques had been discussed. The aim of this chapter is to discuss the underlying research philosophy that has been associated with this study, along with the choice of the research strategy that has been used to conduct this study. Further, the chapter throws light on why case study has been chosen as a research method, for which data has been gathered by means of semi-structured interviews. This chapter will also highlight the use of the data collection instruments, the subsequent data analysis technique that has been used to analyze the data, and the various issues pertaining to the reliability and validity of the given study. Therefore, I first begin with the underlying research philosophy associated with the given study.

### ***3.1 Research Philosophy***

The main issue that has been addressed by social ontology is whether social entities can and should be considered objective entities that have a reality external to social actors, or whether they can and should be considered social constructions built up from the perceptions and actions of social actors Bryman and Bell (2007) pp. 22-23. Further, the authors have classified ontology into objectivism, and constructionism wherein objectivism asserts social phenomena and their meanings have an existence, which is independent of social actors. Thereby suggesting that social phenomenon and the categories that exist in everyday life are independent from actors, which suggests that the world is external and objective, and the observer is independent and value free in the view of science. Whereas constructionism refers to *“that social phenomena and categories are not only produced through social interaction but that they are in a continuous state of revision”* (Bryman and Bell 2007 pp. 23) this suggests that the world is socially constructed and subjective, in which part of it can be observed, and is driven by human interests. In light of the above views, the ontological position of the given study is that of a ‘Realist’, which stands between Objectivism and Constructionism. Wherein I as a researcher want to understand whether the three practical issues identified by Lander and Pinches (1998) acts as a roadblock in the implementation of Real Options Valuation technique in the given case company X in Sweden. However as I have drawn the reality from the work of Lander and Pinches (1998), I as a researcher is also considering the prospect that the reality might be different in the given organization, in order to observe what really exists in a given organization, based on this the ontological stance of the given study is that of a Realist.

Based on the ontological stance, the epistemological consideration is that of a Realist, since *“An epistemological issue concerns the question of what is (or should be) regarded as acceptable knowledge in a discipline”* (Bryman & Bell, 2007 pp. 16). The reason why the epistemological stance of Realist has been taken for the given



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study is that the given study falls between the epistemological positions of Positivism, and Interpretivism. Wherein positivism refers that the researcher takes a stance of a natural scientist, and that reality is measurable and is tangible and looks for facts, therefore a positivist tends to formulate hypotheses, which are subsequently tested, thereby resulting in an end product, which can be generalized. However, for an Interpretivist, reality is not measurable and is intangible, the researcher focuses more on understanding the meaning and tries to understand what is happening by generating ideas through induction. However in case of a Realist the researcher will not only consider the stance of a positivist, wherein the data will be collected based on pre formulated propositions, and will then be analyzed, the researcher will also observe the reality, which might differ from what is described previously (Bryman & Bell, 2007; Saunders *et al* 2007).

Since for the given research study a Realist stance has been taken for both the ontological and epistemological consideration, I have considered of doing a case study within a given organization, wherein the information has been gathered primarily through semi-structured interviews, and supplemented by secondary data provided by the given organization. The reason behind the selection of the above mentioned approach for the given research study, has been explained below in the research strategy section.

### ***3.2 Research Strategy***

As discussed previously based on the ontological and epistemological considerations; the research strategy for the given study follows a qualitative study based on a deductive approach. Wherein the researcher will be testing the roadblocks identified by Lander and Pinches (1998) in the given case company X, which further allows the researcher to capture and understand the reality from the interviewee's point of view in the context of the given company X. To undertake the given study, case study has been used as a research method, which allows the research to gain deep insights in the context of the issues pertaining to the given study.

The nature of qualitative study usually focuses on words rather on numbers while collecting and analyzing data Bryman & Bell (2007). In order to collect and analyze the qualitative data for the given study, the researcher has followed the framework used by Prasad in 1993 (as cited in Bryman & Bell, 2007) which is described below:

Step 1. General Question: As it has already been stated in Chapter 1, the general research question for the given study is:

***“What are the roadblocks associated with the practical implementation of Real Options Valuation technique, in the given company X in Sweden?”***

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Step 2. Selecting relevant sites and subjects: Once the research question and general understanding of the theoretical development was agreed upon between the researcher and the supervisor. The given company was selected which is a pharmaceutical company engaged in new drug discovery, the given organization has been chosen for this study is based on researcher's own personal contacts. This is further supported by the fact that the given organization operates in a business environment of high uncertainty, and have relatively high investments in R&D projects, while makes it ideal to carry out the given research study.

Step 3. Collection of relevant data: once the company was selected, the process for data collection began, since the researcher focus for the given study was concentrated on cross checking the roadblocks associated with the practical implementation of Real Options Valuation technique identified by Lander and Pinches (1998). In total five semi-structured interview were conducted with two programme managers, two project managers, and one project finance director. This has not only provided a platform in understanding what are the various issues involved with the implementation of Real Options Valuation technique in the context of the case company X, but has also helped the researcher to assess the roadblocks identified by Lander and Pinches (1998) and further providing richness to the given study. Since it enables the researcher to capture the view points of different people within the organization, thereby enabling the researcher to draw inferences, and further validate them with the study of Lander and Pinches (1998).

Step 4. Interpretation of data: Since the data for the given study is of a qualitative nature, the researcher has used a deductive pattern matching technique, to identify the roadblocks associated with the practical implementation of Real Options Valuation technique.

Step 5. Writing up findings/conclusions: based on the data analysis, writing on findings would be driven towards the issues pertaining to the implementation of Real Options Valuation technique.

### ***3.3 Research Method***

The research method that has been used to undertake the given study is case study, since case study helps in detailed examination of a single case in question, and the researcher aims to provide an in-depth elucidation of it. (Bryman & Bell, 2007; Saunders *et al* 2007). Case study as research method is of particular interest since it enables the researcher to gain a rich understanding about the context of the given research subject, and the subsequent processes used thereupon Saunders *et al* (2007). The reason why case study has been chosen to undertake the given study can be explained because of a dearth of research done on issues pertaining to the problems associated with the implementation of Real Options Valuation technique.

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Additionally the organization expressed their desire to examine the above mentioned issue in their business environment, which is characterized by a high level of uncertainty. This made the researcher to chose case study as the research method for this study, since it will not only allow the researcher to investigate the research question, in the given organization but will also allow him, to provide deep insights into the myriad of issues pertaining to the implementation of Real Options Valuation technique.

In addition to the above the selected research method has further been segregated into five stages namely - selecting the case; conducting the study; analyzing the case study evidence; developing the conclusion and reviewing the data collection protocol Remenyi *et al* (2005). Since case study is rather inexpensive depending upon the context of the underlying research subject, and the type of data collection technique used. It is quite flexible with respect to a variety of data collection methods used Black and Champion (1976). The principles that govern data collection methods include multiple sources of evidence, which include interviews, documentation, direct observation, participant observation, archival records and physical artefacts; case study database creation thereby increasing the reliability of the given case study; and further maintaining a chain of evidence, in order to allow the reader to follow the derivation of evidence Yin (2003). Therefore, considering the characteristics of a case study, and the context of the given study, the researcher has used documents on tools and techniques for selecting projects based on financial parameters, from the given case company X. The data collection and disseminating process from the previously mentioned sources are based on semi-structured interviews; this has been explained in the following section.

#### ***3.4 Data Collection Tool: Semi Structured Interview***

For the given study Semi-structured interview has been used as a data collection tool, this has been used because semi structured interview not only allows the researcher to gather valid and reliable data relevant to the research question, but it also allows the researcher the flexibility to alter the sequence of the interview questions. The interviewer has an overall structure and direction involving a list of themes and questions to be covered even though these may vary in different interviews. It also provides the interviewer the opportunity to ask related, unanticipated questions that were not originally included in response to what are seen as significant replies, given the nature of events within particular organizations, which may result in unexpected and insightful information coming to light, thus enhancing the findings (Bryman & Bell, 2007; Saunders *et al* 2007).

Since for the given study the research question is the roadblocks associated with the practical implementation of Real Options Valuation technique in the given

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case company X. The opinion and experience of Project Finance Director, Programme Managers, and Project Managers or concerned people involved with the whole process of project selection is really important, with specific reliance on the financial criteria used for evaluating projects, is highly significant for the given research study. In light of all the issues five semi-structured interviews were carried out, the respondents preferred anonymity, and therefore only their designations have been disclosed.

**Table 1: LIST OF INTERVIEWEES**

Sr. no.	Respondent	Designation of Respondent
1	PGM-1	Programme Manager
2	PGM-2	Programme Manager
3	PM-1	Project Manager
4	PM-2	Project Manager
5	PFD	Project Finance Director

The set of questions were first drafted and discussed with the supervisor before the interviews were carried out. The semi-structured interviews for the given study were carried out in the given case company X's premises and in person. The respondents were selected based on their tenure and the designation they hold within the given case company X, the programme managers, and the project finance director had tenure of more than 10 years with the case company X, along with project managers who had been with the given company for more than 5 years. The programme managers are responsible for managing the project portfolio of different projects that are been undertaken in the given company X. The project finance director is responsible for evaluating the projects based on their financial characteristics, whereas the project managers are responsible for managing individual projects, from the conceptualization stage to the end of project. Detailed description about how the process used in conducting the interviews has been presented in the section below.

### ***3.5 Interview Guide:***

To conduct the interviews in a way that provide deep insights with reference to the underlying research question and objectives, care was taken to divide the questions into two parts, the first part was focused on exploring the present financial techniques that the firm uses in selecting projects, and the issues pertaining to them.

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The second part focuses more about the use of Real Options Valuation technique, and issues pertaining to the same, in the given case company X. The set of questions, as appended in (Appendix-1), were developed by the researcher in order to carry out the given research study. The given set of questions are primarily based on the literature review, in particular to the study of Lander and Pinches (1998), based on this, two broad set of questions were formulated in order to facilitate the data collection process, using semi-structured interviews, as depicted in table 2.

**Table 2: Nature and Purpose of Questions**

Set	Nature & Purpose	Questions Asked	Source/Basis
1.	To identify and assess the existing financial evaluation techniques in the given case company X.	Q1 – Q5	
2.	To identify the varying roadblocks associated with the implementation of Real Options Valuation Technique in the given case company X.	Q6 – Q11	Lander and Pinches (1998)

As evident from the previous table the researcher segregated the questions into two parts. Wherein the first part focused on the issues pertaining to the existing financial evaluation techniques, the latter was focused on the issues concerning the application of Real Options Valuation technique in the given company X. The researcher's aim for doing this was primarily driven by firstly focusing on the heterogeneous issues surrounding the existing financial evaluation technique that the company X, uses for selecting projects. Based on these the researcher further tried to cross check the three roadblocks identified by Lander and Pinches (1998). In order to do this for the given research study, semi-structured interviews were carried out face-to-face, within the premises of the given case company X. A detailed description about the data collection process used by the researcher for the given study has been presented in the following section.

### ***3.6 Data Collection Process***

The pre defined set of questions acted as base to initiate the data collection process by means of semi-structured interviews. Before the researcher visited the given organization, the interviewee's were contacted by e-mail and were briefed

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about the context of the study, however they were not provided the questions in advance, since the researcher might not have been able to capture the interviewee's real response. The interviews lasted for 30-45 minutes and the interviewee's response were recorded for which prior permission was obtained from the respondents.

### ***3.7 Types of Data Collected***

Based on the data collection process described above, namely two types of data have been collected primary and secondary.

Primary data, which refers to the data collected from original source, and specifically for the underlying research purpose Saunders *et al* (2007). For the given study the primary data was comprised of the information gathered by means of conducting semi-structured interviews based on the pre defined set of interview questions (see annexe-1). Since the purpose of this study is to confirm the roadblocks associated to the implementation of Real Options Valuation technique, in the given case company X, the primary data takes into account the perspectives of Programme Managers, Project Managers and Project Finance Director. While the secondary data used for the given study mainly involves the information gathered from the company's website, and the company's annual report. The documents and the website is prepared and maintained by the given company.

### ***3.8 Sampling***

As discussed previously for the given study a theoretical sampling technique has been used, wherein the researcher decides what and how much relevant data needs to be collected, and from where it should be collected. Theoretical sampling allows the researcher to base the selection of cases on his judgement as appropriate to best address the research questions, and reaches the set objectives Saunders *et al* (2007).

In order to understand the roadblocks associated with the practical implementation of Real Options Valuation technique, the given company has been selected based on the researcher's personal contacts. Wherein the researcher has used a convenience sample wherein the sampling ended after five interviews, since the researcher decided that theoretical saturation has been attained, and further interviews will not add value to the data collected previously.

### ***3.9 Data Analysis***

Further, once the data has been collected the researcher has used a deductive pattern matching technique Saunders *et al* (2007) to analyze the data collected by means of primary and secondary sources. The data that has been collected is further sub-divided into three sections wherein the first section examines the existing financial evaluation technique that are been practised in the given case company X,

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for selecting projects. The subsequent section focuses on cross checking the three roadblocks identified by Lander and Pinches (1998) for the implementation of Real Options Valuation technique in the given case company X. Finally other potential issues have been examined by the researcher for the implementation of Real Options Valuation technique in the given case company X. In order to embark on this the researcher from the literature review section identified possible terms pertaining to myriad of issues associated with the traditional financial tools and techniques used for selecting projects. Further, the researcher identified patterns based on the study of Lander and Pinches (1998) wherein the patterns were based on the three obstacles identified by the authors for the implementation of Real Options Valuation technique for selecting projects. Since the data was gathered by means of semi-structured interviews, by reviewing though the responses of all the respondents, the researcher tried to identify the patterns similar with the ones identified in the literature review section. To do so, the researcher segregated the data into different parts and tried to identify similar patterns, and as a result, the answer for the research question. Additionally, if successful this further improved the internal validity of the research.

#### ***3.10 Reliability and Validity***

In the context of the given research study, reliability addresses the issue, whether the results of the given research study can be repeated or not? To address the issues pertaining to reliability and validity of the given study, the researcher has broadly used the framework suggested by Yin (2003) to ascertain the quality of the given study. The framework given in Table 3 explains the different steps that the researcher has undertaken in order to fulfil the requirements for conducting a valid and reliable study.

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**Table 3: Testing Validity and Reliability for Case Study (Yin, 2003)**

Tests	Case Study Tactic	Phase of Research	Steps Undertaken
Construct Validity	<ul style="list-style-type: none"> <li>Use multiple sources of evidence</li> </ul>	Data Collection	<ul style="list-style-type: none"> <li>The sources of evidence used for the study are based on the official company documents (annual report, and other internal documents) and interviews (semi-structured interviews conducted with different personnel's within the case company X, ranging from Programme Managers, Project Finance Director to Projects Managers).</li> </ul>
	<ul style="list-style-type: none"> <li>Have key informants review the draft case study report</li> </ul>	Collection	<ul style="list-style-type: none"> <li>Because of the time constraint, it was not possible for the informants to review the draft case study report. The respondents have reviewed the summary of the findings based on what was asked during the interviews. Thereby allowing the respondents to agree or disagree with the understanding of the researcher.</li> </ul>
Internal Validity	<ul style="list-style-type: none"> <li>Do Pattern Matching</li> </ul>	Data Analysis	<ul style="list-style-type: none"> <li>Lander and Pinches (1998) identified three roadblocks associated with the implementation of Real Options Valuation technique while evaluating projects. The researcher while doing the analysis tried to compare whether the three roadblocks existed in the given case company X. In addition to this there has been several studies which have highlighted that Real Options Valuation technique provides decision makers a more holistic view of the project based on financial parameters (Trigeorgis, 1993; Dixit &amp;</li> </ul>



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Internal Validity	<ul style="list-style-type: none"> <li>Do Pattern Matching</li> </ul>	Data Analysis	<ul style="list-style-type: none"> <li>Lander and Pinches (1998) identified three roadblocks associated with the implementation of Real Options Valuation technique while evaluating projects. The researcher while doing the analysis tried to compare whether the three roadblocks existed in the given case company X. In addition to this there has been several studies which have highlighted that Real Options Valuation technique provides decision makers a more holistic view of the project based on financial parameters (Trigeorgis, 1993; Dixit &amp; Pindyck 1995; Luehrman, 1998; Copeland &amp; Keenan, 1998). The researcher tried to identify other issues pertaining to the implementation of Real Options Valuation technique in the given case company X.</li> </ul>
External Validity	<ul style="list-style-type: none"> <li>Use replication logic in multiple case studies</li> </ul>	Research Design	<ul style="list-style-type: none"> <li>The given study is a single case study, wherein financial evaluation techniques used by the given case company X, have been studied, and based on that the three roadblocks identified by Lander and Pinches (1998) have been cross checked concerning the implementation of Real Options Valuation technique while selecting projects. The researcher has done an extensive job of describing the underlying research context, and has therefore tried to ensure that the given study, if at all can be transferred in other settings, with similar contexts.</li> </ul>
Reliability	<ul style="list-style-type: none"> <li>Develop case study database</li> </ul>	Data Collection	<ul style="list-style-type: none"> <li>The data that has been collected for the given study is based on official documents and interviews. However the data collected has been separated from the</li> </ul>

			requirement of the given case study.
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### ***3.11 Ethical Considerations:***

In the context of the given study, the ethical principles are considered as “*Harm to participants, Lack of Informed Consent, Invasion of Privacy, and Deception*” (Bryman & Bell, 2007). These issues with respect to the given study are addressed by means of informing the respondent’s in advance about the research objectives, and the relevant areas the study will be focusing on. To further elucidate on this prior consent was obtained from the respondent’s concerning the information that can be made public. However, since the given company engages in a highly competitive industry, the respondent’s were assured that all the information will be treated confidentially, and that the identities of the respondent’s will not be disclosed in any of the official publication, as part of the study.

### ***3.12 Summary***

In order to understand the roadblocks associated with the practical implementation of Real Options Valuation technique, the researcher has taken a realist stance of ontology and epistemology considerations. Further, the given research study follows a qualitative study, based on deductive approach. In order to further justify the nature of the research, and dearth of research in the given field, a case study which will provide the researcher deep insights to the issues pertaining to the implementation of Real Options Valuation technique in depth, the researcher has used semi-structured interviews to collect the data, based on the pre formulated questions. The researcher has chosen the company based on personal contacts, and has further used a theoretical sampling technique to carry out the interviews, which has been discussed previously. In addition to this, the researcher has discussed about the issues pertaining to the reliability, validity and ethical considerations of the given study. Based on this the subsequent chapter focuses on how the data has been analyzed, for the given study.

## **CHAPTER 4 – ANALYSIS**

### **4.1 Introduction**

As discussed in the previous section, the given study is based on a case study that researcher has carried in a given case company X wherein the researcher has tried to understand the myriad of issues associated with the practical implementation of Real Options Valuation technique, while selecting project based on the projects financial characteristics. Based on the data collected through semi-structured interviews and using a deductive pattern matching technique, the skeleton of the analysis is built in the following order:

- ◆ Firstly, a brief description will be presented based on how projects are selected in the given case company X.
- ◆ Secondly, a broader description pertaining to the existing financial evaluation techniques in the given case company X will be presented.
- ◆ Thirdly, as the main objective of the study is to cross check the three roadblocks associated with the implementation of Real Options Valuation technique, identified by Lander and Pinches (1998) the same will be pursued.
- ◆ Finally identifying other roadblocks that might have surfaced based on the responses provided by the respective respondents in the given case company X.

### **4.2 Interview Findings and Analysis**

Based on the order of the sample interviewees in section 3.4, the respondents will be referred to when necessary by using the following abbreviations: PGM-1, PGM-2, PM-1, PM-2 and PFD, wherein PGM, PM and PFD refers to the Programme Manager, Project Manager, and Project Finance Director within the given case company X.

### **4.3 Project Selection Process in Company X**

For the given case company X, the project selection process stems out from the organization's view to investigate the unmet medical needs that exist in the market place. Here the focus is more on the biological compounds and the perceived likelihood of finding a good chemistry associated with them, which are then been investigated, along with their likelihood to get the necessary approval from the regulatory authorities in different geographical locations. Further while making the go/no-go decision the organization also considers about the compounds perceived value in the market place and research costs involved with the same (PGM-1). In addition to this (PGM-2), states that as the project become closer to the launch in the market, the more expensive and resource consuming they become, and therefore

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larger is their impact of any go decision. The tools used in order to make the go/no-go decisions are “*fairly standard and rudimentary portfolio management tools, predominantly based on value and risk*”, this finally comes down to the judgement of the decision bodies. Further, (PM-1 & PM-2) adds that during the project selection process, there are different milestones during the project phase wherein once the project reaches a given milestone its performance is been reviewed, and is been assessed with respect to the expected results, established in the beginning. Based on these the project gets a go/no-go decision. Further these milestones are created internally within the company and are referred as ‘Toll Gates’, within the organization, and are standard for all projects. As the projects start consuming more resources the more scrutiny it gets from the supervisory board primarily, Commercial Product Review Board (CRB), and Product Review Board (PRB). The former is responsible for the commercial aspects pertaining to a given project namely the expected sales figures, volumes, and the expected size of the market, whereas the latter is responsible for the technical aspects of the given project, namely efficacy and safety issues pertaining to a given project. Further to this (PFD), sheds some light on the financial perspectives that are been considered while selecting a project, which according to him is predominantly based on the NPV envelope wherein a very limited set of scenarios are been considered. These are prepared by the respective project teams, and based on these scenarios’ probability of its occurrence is determined by using statistical tools and techniques, thereby arriving on a go/no-go decision.

#### ***4.4 Existing Financial Evaluation Technique in Company X***

The financial evaluation technique that the company X uses for selecting projects is primarily based on the Net Present Value (NPV). However in the context of the given case company X, the company assigns probabilities to a number of scenarios, which are been developed by the respective project teams, based on different parameters. This primarily addresses the degree of uncertainty involved with the given project, pertaining to if the new drug will be first to the market, or if there is not enough patient population to carry out the clinical trials. Further (PGM-1) adds that the assumptions that are used while making these scenarios are so difficult to define in a good way, that a slight change in one parameter can have a profound implication on the overall project. Relying on these scenarios, the given company calculates the NPV for each scenario, and further takes a weighted average of them. Based on the probability of there occurrence and it arrives on a Expected Net Present Value (E-NPV). Further, it also assigns probabilities to each project with respect to different stages, within the portfolio at a fairly generic level, thereby making a small decision tree (PFD). In addition to this (PGM-2) adds that in the beginning the portfolio committee that oversees all the projects in the company’s global portfolio reviews the molecule along with its characteristics, and prospects along with the value

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propositions it can offer, at the given point of time. (PGM-2) further stresses, that the hard financial matrix is based on peak year sales or market size for a disease area. In order to get a good approximation of the value associated with the project, before making investments, and later on as clinical data comprising of patient data, efficacy data is revealed from the sample population, a better understanding of the project is revealed in terms of value propositions, coupled with the risks associated with it, from herein the NPV, and IRR starts playing a major role. Additionally, in the given case company X, the risks and value associated with a given project are treated separately; wherein the risks associated with a given project is calculated by using scoring models developed internally within the company. Pertaining to typical activities, that might can occur during the project lifecycle, for instance the risk of not finding a good formulation, or the risk of not finding correct dosage, which happens quite often (PM-1 & PM-2). These risks are taken into account by means of a package of different scoring models, which are been assessed at the beginning of the project. The (PGM-2) further adds that weighted average of the financial models, which in the case of given company X is Net Present Value (NPV), takes into consideration the probability of launch, therefore the financial evaluation technique is more of a probability adjusted financial metric, wherein probabilities are assigned to different scenarios. Based on their mean average a reasonable forecast is been made, however (PGM-2), along with (PGM-1) and (PFD) casts their doubt on the reliability of the forecast, since the forecasts are made for 10 to 12 years in the future.

In addition to this the present financial evaluation technique of Net Present Value (NPV) focuses solely on a positive Net Present Value (NPV) or the Expected Net Present Value (E-NPV) to take care of different probabilities assigned to a given project, as well as the company's Internal Rate of Return (IRR) and the company's cost of capital (PFD). Further, specific variations in parameters are pre agreed by the project team primarily stemming out from price evolution of the drug, competitor's entry, thereby creating different scenarios and by means of sensitivity analysis, ascertaining their effect on the sales forecasts. The (PFD) further explains that the financial evaluation techniques play an important role at Toll Gate-3. This is before the beginning of phase-3 clinical trials, though the financial technique plays some role at Toll Gate 2.5, before the start of phase-2 clinical trials. However, the major financial decisions are taken at Toll Gate 3, since prior to this the company has spent approximately 50 million USD. Nonetheless in phase-3 studies, the company intends to spend approximately 300-400 million USD, before going for regulatory approval. Therefore, at Toll Gate 3 the company rigorously scrutinises the project, including the sales forecasts associated based on a number of assumptions and the subsequent scenarios along with the probability of their occurrence.

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The probabilities of success for a given project are determined by using statistical data, available from the given therapeutic area based on internal company guidance (PM-1 & PM-2). The project will receive a go signal if it has a positive Net Present Value (NPV). The project team always commits the Net Present Value but in addition to this some sensitivity analysis are also provided with the given Net Present Value because of the disparate uncertainties surrounding the project. There are different assumptions pertaining to the drug making its entry to the market. The key is what are the assumptions behind the Net Present Value, since based on the Net Present Value different forecasts are provided and then based on these figures the project financial approval committee looks into the respective sales volume, and gross margins that will be generated by the given project. However, (PM-1 & PM-2) further add that the senior executive committee, which gives the final go head to the project focuses more on the Net Present Value of the given project and the underlying assumptions associated with it.

The (PM-1 & PM-2) further explains, that during the initial phase of the project the primary risks that are been considered, usually stems out from the unmet medical needs within a given therapeutic class. The real focus on the financial evaluation of the project comes in Toll Gate 3, as this is where the project requires substantial financial commitment. Further to this it has been observed that the present financial evaluation technique, which for the given case company X is Net Present Value (NPV), changes dramatically as planned in the beginning. Since quite often the financial decisions are solely on the Net Present Value (NPV) therefore at times it can be very counter intuitive or uncertain because of the constantly changing external environment, and the change in the risk profile of the project owing to new information made available at different milestones during the project lifecycle. Further (PM-1 & PM-2) elaborates that if during the project lifecycle there are some negative indications pertaining to the given project comes up, then the Net Present Value for the given project is calculated again for the given scenario, and the project team tries to determine its sensitivity on the whole project.

#### ***4.5 Cross checking the roadblocks identified by Lander and Pinches (1998)***

In order to cross check the study done by Lander and Pinches (1998), for the roadblocks identified for the practical implementation of Real Options Valuation technique, as a means for selecting projects, in the given case company X. The researcher asked the respondents a series of questions based on what are the different options that managers possess, and can exercise during the different stages in the project lifecycle, how are these options valued etc. based on these questions respondents response in the given case company X are presented down under.

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The three options identified by (PGM-1) that project managers possess and can be exercised during the project lifecycle are the option to abandon, option to wait for more information, and the option to accelerate the project, based on favourable market conditions, or good clinical data results. However when asked about how the given case company X, values these options (PGM-1) responded that the value of these options are taken into consideration at an intuitive level, but not while evaluating the projects on financial parameters. When the researcher asked (PGM-1) about his awareness of Real Options Valuation technique, the respondent replied that he is unaware of any financial evaluation technique that can value the options embedded within the project. In addition to this, (PGM-2) states that project managers during the project lifecycle do possess in addition to the above-mentioned options, the option to switch, which arises in the form of a new compound, arising from the same molecule with different biological indications. However, (PGM-2) further admits that within the case company X, there is no structured methodology to value these options, while making investment decisions. In addition to this, (PGM-2) further states that whenever a new event or new clinical data is revealed or a change happens in the external environment, which makes it much more difficult to get approval from the regulatory authorities, for the given compound. The portfolio management team addresses these changes if it is a minor change, then the project team itself recommends the necessary action. However it is essentially the decision of the governance body depending on the magnitude of the event, for the necessary steps needs to be taken. For minor changes financial matrices are not calculated, but if in case the change is a major one, then the whole business case is recalculated. The governance body comprises of senior managers but also takes recommendation from the preparatory group that does all the analysis. This preparatory group is a central independent group that functions across the businesses globally. The preparatory group is responsible for making recommendation to the governance body for any unexpected change in the external environment of all the projects in the company's portfolio.

Further when the researcher asked (PGM-2) about his awareness about the Real Options Valuation technique for selecting projects, the respondent replied that he is aware of the technique, however at a very basic level stemming out from his personal interest in the stream of options valuation. However, (PGM-2) states that one of the main obstacles for the implementation of Real Options Valuations technique is that even though people may understand financial options, they aren't clear in their minds as to how to apply it for financial evaluation of projects, he further goes on in saying that in order to build confidence in concepts like Real Options Valuation, programme and project managers needs to be exposed to the thinking and ideas behind it. The reason for this stems out from the view that, in order to adopt a modern portfolio management tool for evaluating projects based on financial parameters, the

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senior people within the governance body, and the decision body should support it. Which in the given case company X hasn't been possible, further the Real Options Valuation technique hasn't been very much welcomed by the financial people owing to the complex calculations and several assumptions involved while valuing projects, along with this very few people in the given case company X, are aware of Real Options Valuation technique.

Further when the (PFD) was asked about the problems associated with the existing financial evaluation technique of Net Present Value (NPV) in the given case company X, the respondent replied that the given financial evaluation technique of Net Present Value (NPV) at given case company X doesn't takes into account the value of options that are embedded within the projects. Further it fails to bring forward the opportunity i.e. the options embedded within the project that managers possess, for example *"how can I get to the next decision point in a cheaper and smarter way"*. Moreover, the focus of the existing financial technique is more on the expected pathway of the project, determined in the beginning of the project and neglects the importance of the new information that allow managers to make more informed decisions. However when the researcher asked the respondent about his awareness about the Real Options Valuation technique, the respondent replied that he is aware of the Real Options Valuation technique to a limited extend, which stems out from his training at the university, however he has never used it in practise.

The respondent acknowledged the options that are been identified by (PGM-1 & PGM-2) that managers possess and can exercise during the project lifecycle. However the respondent further adds that it is a parallel exercise wherein these different options are considered, but in practise the value of these options is disregarded in the base case. When asked, what does the company do, when the risk profile of the project changes with the availability of new information? The respondent replied, that the risk profile of the project is regularly monitored by the portfolio management team and for any change in the risk profile of the project during the project lifecycle, the portfolio management team maintains a risk register for all the key risks pertaining to a given project, which is been updated on a regular basis. Further, all high and low risks are flagged to the senior management and based on this the project manager plans a risk mitigation plan.

When asked, about the reasons why Real Options Valuation technique is not used in the given case company X for selecting projects, the respondent replied, *"The appetite amongst senior management for analytical financial evaluation techniques for selecting projects is very limited"*. The reason for using Net Present Value (NPV) or Expected Net Present Value (E-NPV) stems out from the fact that it is much simpler and easier to understand and is supported by the senior management. Since


















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the senior management is very sensitive to the value assigned to the project in the beginning. For example at one milestone the value of the project is 1 billion USD, and at the next milestone the value becomes 50 million USD, because of this change in the internal or external business environment, senior management and shareholders becomes sceptical, and that reduces their appetite for having even more refined financial evaluation technique like Real Options. Further apart from this one of the key reason for Real Options Valuation not been used as a financial evaluation technique while making investment decisions, is that Real Options technique is quite complicated owing to complex calculations of all the options and assumptions that needs to be considered while valuing projects. Coupled with the unawareness of Real Options Valuation technique among personnel's who take final decisions while selecting projects, since these personnel's are not exposed to analytical financial evaluation techniques like Real Options, it becomes difficult within the case company X, to adopt modern financial evaluation technique.

When the researcher asked (PM-1 & PM-2) about the different options, which project managers possess during several stages of the project lifecycle, the respondents replied that they have the option to abandon, option to delay and option to expand. In case the clinical results are unsatisfactory there is the option to delay and an option to expand is there in case the results are favourable or the external business environment has changed. For example, a competitor has abandoned a similar project with, similar biological compound. (PM-1) has further stated that the given case company X has no mechanism to value these options. However, when the respondent asked both (PM-1 & PM-2) about their awareness of Real Options Valuation technique, the respondents replied that they are unaware of any such technique, that value the options that are embedded within the project. In addition to this (PM-2) adds that in case the risk profile of the project changes during the project lifecycle, at each milestone the project review committee is updated about any change in the risk profile of the project, and in case if the project profile seems to be different as it was planned in the beginning, the whole business case is updated and the governance body is informed.

**Table 4: Graphical Representation of Checking the Three Roadblocks Identified by Lander and Pinches (1998)**

Roadblocks Respondents	Unawareness Among Corporate Managers and Practitioners of Real Options Valuations Technique		
	Complex Modelling Assumptions	Additional Assumptions for Mathematical Tractability	
PGM-1			
PGM-2			
PFD			
PM-1			
PM-2			

Description of Legends:

 - Roadblock found

 - Roadblock not found

#### ***4.6 Other potential roadblocks identified based on respective respondents response***

In addition to cross checking the three roadblocks identified by Lander and Pinches (1998), (PMG-2) has discussed on how to calculate and ascertain the degree of risk for a given project, which in case of financial options is the risk of the underlying asset, and is a key input in order to derive the value of the option. (PMG-2) further, states that in case of financial options the degree of risk is derived by means of historical time series data of the underlying risky asset, which for projects in the given case company X, is rather impossible to obtain. As there is no

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time series data available, much of the projects that the given case company X undertake, are focused on new markets, which don't even exist in the market place. Therefore, it becomes rather complex to quantify these risks, and reasonably allocate a unit to them. This coupled with senior managements lesser attention towards complex analytical techniques like Real Options Valuation, tends to drive the organization in another direction. This is further supported by the likeness of financial community within the case company X, towards the tools available to them, which are easy to understand and well accepted by the shareholders, keeps the given case company X away from analytical techniques like Real Options Valuation. In addition to this (PFD), states that one of the reasons why Real Options Valuation hasn't been popular within the case company X is that there are several projects that the given case company X, undertakes at any given point of time and the decisions at different milestones are not made at any fixed time interval. This makes it difficult to implement Real Options Valuation technique in the given case company X, as one of the key input on which the value of the option depends is the time to expiration of the option, which for the given case company X, varies from project to project. Therefore, this aspect makes it difficult to compare identical projects with different time to expiry of the option. This coupled with the lack of support for Real Options Valuation technique from the senior management and the key decision making bodies within the case company X, makes it unpopular within the given case company X and acts as a hindrance in its implementation.

#### ***4.7 Summary***

In order to understand the diverse roadblocks associated with the implementation of Real Options Valuation technique in the given case company X first the present financial evaluation technique used in the given case company X was analyzed. Subsequently the three roadblocks identified by Lander and Pinches (1998) pertaining to the practical implementation of Real options Valuation technique in the given case company X were cross checked. Then other roadblocks pertaining to the Real Options Valuation technique in the given case company X were identified on the basis of the responses provided by the respective respondents. The following chapter focuses on analysing the findings of data analysis gathered by the researcher by using semi-structured interviews in the given case company X, and the analysis of the literature review done in chapter 2.

## **CHAPTER 5 – DISCUSSION**

### ***5.1 Introduction***

In the previous chapter, the existing financial evaluation technique used for selecting projects in the given case company X were analyzed using a deductive pattern matching technique. Based on the data gathered by the researcher by means of semi-structured interviews carried out within the given case company X the researcher also analyzed the roadblocks identified by Lander and Pinches (1998) concerning the implementation of Real Options Valuation technique while selecting projects. In addition to this the researcher also tried to identify other potential roadblocks apart from the ones identified by Lander and Pinches (1998) for the implementation of Real Options Valuation technique in the given case company X.

In the given chapter, the researcher will discuss a variety of reasons within the case company X that acts as a hindrance for the implementation of Real Options Valuation technique for evaluating projects. The data presented are collected from primary sources by means of interviews and through secondary sources such as guidelines of the case company X.

### ***5.2 Existing financial evaluation technique in company X***

In the context of the given case company X, the respondents revealed that the company uses Net Present Value while selecting projects, wherein sales forecasts are generated based on different scenarios provided by the respective projects teams. Then these are discounted back to present term, by applying a reasonable risk premium along with the company's cost of capital. This provides the company the present value of the future cash flows, from which the initial investment for a given project is subtracted and thus Net Present Value is obtained (Damodaran 2001). If the value is positive then the project is included in the global project portfolio of the given case company X, else the project is rejected. As the company operate in a very dynamic, and highly uncertain business environment. The projects are generally focused towards meeting the demands of the markets, which may not even exist. These markets primarily stem out from the unmet medical needs. The project team makes a number of scenarios, and the Net Present Value of these scenarios is calculated. Further, a weighted average is applied, based on the probability of their occurrence, and an Expected-Net Present Value (E-NPV) is obtained.

### ***5.3 Issues pertaining to the existing financial evaluation technique of Net Present Value (NPV) in the given case company X***

Though the given case company X, uses Net Present Value as a technique for selecting projects, there have been certain issues pertaining to its accuracy with respect to the ranking it provides for selecting projects, within the company X. One of the issues that has been identified by all the respondents is that the given financial evaluation technique fails to incorporate the value of managerial flexibility, or the options that managers possess which are embedded within the project. Since the present technique relies on a pre-established path of expected stream of future cash flows, it fails to factor in the value of new information, that managers will have as the project progresses due to the changing external business environment and/or unsatisfactory clinical data (PM-1 & PM-2). As the projects within the given case company X, usually lasts for more than 10 years, and the investments are made at different milestones during the project lifecycle, the present technique neglects this high degree of uncertainty, and the change in the risk profile of the project. Infact, the new information made available to the managers can significantly alter the pre-established investment phases, and resulting forecasts (PFD). This is in line with what Trigeorgis (1993) and Leuhrman (1998) have suggested. The Net Present Value is inadequate for the capital budgeting process, as it fails to take into account management's flexibility to revise their decisions in response to unexpected market developments.

In addition to the above, one of the key aspect that has been highlighted by the (PGM-2) and (PFD) refers to degree of uncertainty involved with the business, in which the given case company X operates. The respondents added that the because of this high degree of uncertainty, and the given case company X reliance on favourable clinical data, usually the outcome of the project deviates from the pre determined path designed in the beginning of the project. Since on an average it takes more than 10 years to get a new drug into the market (PGM-1), this coupled with clinical trial results and stringent government regulatory norms for new drug approval, therefore leads to a high failure rate of projects within the given case company X. The present technique ignores these parameters, which have strong impact on the overall value of the project, and needs to be factored in while valuing projects.

#### ***5.4 Three Roadblocks identified by Lander and Pinches (1998)***

##### **5.4.1 Unawareness of Real Options Valuation technique among corporate managers and practitioner's**

In the given case company X, though all the respondents acknowledged that managers during the project lifecycle at different decision points, do possess certain options, however all the respondents agreed that the given financial evaluation technique, doesn't take into account the value of these options. In addition, to this when the researcher asked the respondents about their knowledge of Real Options Valuation technique for valuing these options that managers possess, across different decision points during the project lifecycle, three respondents (PGM-1, PM-1 and PM-2) acknowledged that they are completely unaware of the Real Options Valuation technique. Further (PGM-2 and PFD) acknowledged that they have some knowledge of financial options, but not of Real Options Valuation technique.

##### **5.4.2 Complex Modelling Assumptions**

When asked about the modelling assumptions required for valuing projects using Real Options Valuation technique, (PGM-2 and PFD) added that since the given case company X, operates in a highly uncertain business environment, and on an average projects lasts for more than 10 years, it becomes really complex to factor in all the assumptions involved, with a given project.

##### **5.4.3 Additional Assumptions for Mathematical Tractability**

In response to the additional assumptions required for mathematical tractability. One of the key concerns that have been highlighted by the respondents was in order to factor in the additional assumptions required for the mathematical tractability of the model. The personnel's within the project team does not possess the advanced knowledge of mathematical models, which further limits the applicability of Real Options Valuation technique to evaluate projects, in the given case company X.

#### ***5.5 Additional roadblocks outside the framework of Lander and Pinches (1998)***

In addition to the three roadblocks that were identified by Lander and Pinches (1998) for the implementation of Real Options Valuation technique for evaluating projects, there were some other issues that were identified by the respondents, in the context of the given case company X. One of the key issues that has been highlighted by the (PGM-2 & PFD) has been that one of the key input on which the Real Options Valuation technique is dependent, when doing project valuation by using Black-Scholes model for valuing an option, Hull (2000) is the risk or variance ( $\sigma^2$ ) of the underlying asset. This in case of financial options is calculated by using historical

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time series data available for the traded risky asset. However, in the given case of company X, this seems to be rather difficult. Since the projects that are been undertaken by the company X, are so different from each other that there is no historical time series data available, and therefore it becomes rather difficult to ascertain an appropriate degree of risk for the specific project. Further in case of financial options, the assumption is that the variance of the underlying asset, is known and does not change over the life of the project. However in case of real options this assumption doesn't holds true since the variance is unlikely to remain constant, over extended time periods and infact may be difficult to estimate at the very first place Damodaran (2005).

Also in the given case company X, another point regarding the implementation of Real Options Valuation technique, stems out from the fact that the timing of the projects, and the resulting investment time points are different. Therefore, the resulting values that are been obtained, while using the Black-Scholes option valuation model Hull (2000) are not comparable, since one of the key input in the options valuation model, is the time to expiration of the option (t), Hull (2000), which in the given case company X, as highlighted previously are different for different projects. Therefore, it further makes it difficult within the context of the given case company X, to compare projects at a given milestone. Since not all the projects reach the same milestone simultaneously, and if the projects are put on hold on a given milestone in order to compare with the other projects then the project is delayed and creates a disadvantage for the given case company X. In addition to this, another factor that further makes it difficult to apply Real Options Valuation technique in the given case company X has been that of valuing financial options. One of the key assumptions is that the underlying asset is traded and that a replicating portfolio can be created using the underlying asset at the riskless borrowing and lending rate. However, this assumption comes under fire in case of Real Options, as the underlying asset, which in the given case company X are the different projects, which are not traded and therefore there are no arbitrage opportunities. Thereby in case of valuing options on assets that are not traded, it becomes difficult to interpret the values from the option pricing models Damodaran (2005). In addition to this, another important dimension that has been brought forward by the (PGM-1, PGM-2 & PFD), has been the lack of senior management support towards newer analytical evaluation techniques for making investment decisions. Since the senior management has been focused primarily around the existing well-established techniques, which are relatively easier to understand and implement and are used across the industry. This coupled with the preference of the financial community within the company X towards more probabilistic risk assessment techniques of Expected-Net Present Value (E-NPV), tends to take the organization in a different direction. This is further supported by the survey done by Hartmann and Hassan (2006) on application of Real

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Options Analysis for valuing pharmaceutical R&D projects, the findings of the survey, shows that the Real Options analysis hasn't received enough support from the decision makers across different pharmaceutical companies.

#### ***5.6 Summary***

In the given chapter the researcher has tried to find similarities between the findings from the data analysis section, and the literature review section. Based on these the next chapter will focus towards the researchers' conclusion about the given study, the researcher will also discuss the strength and weakness of the given study, and further present the researchers' views towards future research.



## **CHAPTER 6 – CONCLUSION**

### ***6.1 Introduction***

In order to understand, what are the various roadblocks associated with the implementation of Real Options Valuation technique; while evaluating projects based on financial parameters, the researcher took the framework of Lander and Pinches (1998). In the study, the authors had identified three roadblocks associated with the practical implementation of Real Options Valuation technique. Therefore, based on the identified roadblocks, and to assess their validity; the researcher by using a qualitative research approach carried out a case study in a given company X in Sweden. Additionally for the given study the researcher used semi-structured interviews as a data collection tool to gather the required data for the given study. The interviews were conducted namely with the respective Programme Managers, Project Finance Director and Project Managers in order to analyze how projects are selected based on financial parameters in the given case company X. This was followed by a deductive pattern matching technique to analyze the data for the given study. Thereby subsequently identifying what are the different issues associated with the existing financial evaluation technique in the given case company X. Further, based on the identified issues, the researcher has tried to assess the diverse roadblocks that lead to the non implementation of Real Options Valuation technique within the given case company X.

### ***6.2 Answering the Research Question***

The researcher's conclusion with respect to the research layout is presented down under. The researcher reviewed an extensive amount of literature in order to answer the research question: *“What are the roadblocks associated with the implementation of Real Options Valuation technique in the case company X in Sweden?”* Further, the researcher has identified a myriad of tools and techniques, which the given case company X uses in order to evaluate projects based on financial parameters. The research showcases that even though there exist some issues with respect to the existing financial tools and techniques that the given case company X uses for selecting projects. However, it doesn't make it easier for the company X to adopt analytical evaluation techniques for evaluating projects like Real Options Valuation. Though there have been academic studies that have showcased that Real Options Valuation do capture the value of managerial flexibility and the value of new information, in businesses which operate in a business environment of high degree of uncertainty (Trigeorgis, 1993; Dixit & Pindyck, 1995; Luehrman, 1998; Kogut & Kulatilaka, 2001). But there are certain issues pertaining to the lack of awareness among decision makers for analytical evaluation techniques like Real Options, and the issues concerning the disparate assumptions, and complex mathematical

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calculations, which further makes it difficult in the context of given case company X to adopt analytical project evaluation technique like Real Options.

The researcher's aim was to identify a number of issues involved with the implementation of Real Options Valuation technique in the given case company X in this chapter the researcher will provide recommendation to the different issues that are faced by the given case company X while selecting projects. These recommendations will hopefully try and resolve the several issues/problems associated with the implementation of Real Options Valuation technique, for selecting projects in the given company X.

### ***6.3 Managerial Implications***

Based on the findings of the given study, the management's focus in the given case company X on selecting projects solely based on the risk assessment, and the potential future forecasts generated in the beginning of the project. This may not be the ideal criterion, for case company X given the fact that its projects bear high risk, within a constantly changing business environment. The organization should need to take into account the value of managerial flexibility in lieu of the new information. This allows managers to make decisions that are more informed and thereby creating value for the organization. As for the given case company X the failure rate of the projects is high, this coupled with the dynamic nature of the business environment, and the significant high initial investments required for undertaking projects. The given company X needs to take into account the value of the different options that managers possess during the project lifecycle, and thereby valuing projects more accurately.

The study further suggests that the decision makers, needs to be aware of analytical evaluation techniques like Real Options for selecting projects and should also try and promote the same within the organization. Since the existing financial evaluation technique fails to take into account the above mentioned issues, that are necessary in the context of given company X to value projects accurately. According to Lander and Pinches (1998), one of the key reasons for Real Options Valuation technique not being implemented in businesses, is that senior managers and decision makers are unaware of this analytical technique for selecting projects. In addition to the miscellaneous assumptions associated while valuing projects using Real Options Valuation technique.

The researcher by means of the given study suggests that selecting projects, within any organization plays a very crucial role as many organizations tends to undertake those projects that create the maximum value for the organization and for the respective stakeholders involved Damodaran (2001). However, organization need to be careful, while using different tools and techniques for selecting projects as the

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application of any given tool and technique, for selecting projects should take into consideration not just the primary risk, and returns of the project calculated in the beginning of the project. It should take into account the change in the risk profile of the project, especially in dynamic business environments and the value of the new information, that allows managers to make informed business decisions.

#### ***6.4 Theoretical Implications***

The findings of the given study make a contribution in the areas of project management, concerning project selection based on financial parameters. Additionally it also provides researchers new dimensions to further investigate on a number of aspects that have been identified with respect to the implementation of Real Options Valuation technique.

The given study reveals that several academicians have demonstrated that Real Options Valuation is a better technique compared to the existing financial evaluation techniques used for selecting projects (Trigeorgis 1993, 2005; Copeland & Keenan 1998). However, there are number of issues that need to be addressed before Real Options Valuation technique can be implemented across businesses. Even though the given technique takes into consideration managerial flexibility, pertaining to the value of new information, however, one of the key issues is concerning the several assumptions, and the complex mathematical calculations make it unpopular across businesses.

#### ***6.5 Recommendations***

The researcher based on this study, will present his recommendation to the senior management, and project management department, concerning the financial evaluation techniques used within the case company X for selecting projects. From the analysis chapter it can be inferred that the given company X uses financial tools and techniques for selecting projects, as identified in the literature review chapter. However there exists a possibility for the given company X to adopt better analytical techniques like Real Options Valuation for selecting projects.

The following recommendations are been proposed to case company X's management:

##### **Emphasis on the awareness of analytical techniques like Real Options:**

The top management should ensure that people within the finance department and the project management team are aware of newer tools and techniques like Real Options. Industry experts can do this by means of organizing workshops, and attendance should be made compulsory.

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### **Employing people who understand advanced mathematical tools and techniques:**

The top management should ensure that there are personnel's within the organization that are well versed with advanced financial tools and techniques that are required to value projects by means of Real Options.

### **Encouraging people to bring new ideas for evaluating projects:**

The organization should encourage and motivate people towards adopting newer tools and techniques to evaluate projects, and thereby assessing their value more precisely.

## ***6.4 Strengths and Weaknesses***

The given study has a scientific credibility, which can be ascertained by the researcher's use of scientifically accepted method. In the context of the given study, the literature review provides a grounded theoretical base, and the empirical findings are clear and fit with the existing theory. The given company X that has been studied is respectable in the pharmaceutical industry, and the researcher believes that the findings of the given study can be applied to other organizations of a similar size operating in a similar industry. The researcher access to best informants for the best interviews, based on their seniority within the given company X and years of experience, further adds to the interviewees been considered as best informants.

However one weakness that can be attributed to the given study, can arise out of the fact, of researcher's limited access to documentation pertaining to financial parameters used for selecting projects. Since the information was of material nature, and was deemed sensitive by the company officials, and therefore was not been disclosed to the researcher as part of the study. In addition to this the fact that only one company has been analyzed as part of the study, makes the result not generalizable to an extended community. Considering the extensive amount of literature reviewed for the given study, there are many articles and publications in the context of the given research topic, that the researcher has not been able to use, and reference for the literature review, which has provided a theoretical base.

## ***6.5 Recommendations for future research***

In order to extend the scope and results of the given study, a quantitative research can be undertaken. Wherein by means of advanced statistical tools and techniques, correlations and links can be explored in the findings stage, which as part of the given study were not considered by the researcher. A quantitative study will help in generalizing the study, based on the higher number of respondents, and the subsequent additional number of organizations involved.

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A quantitative study will further help in identifying the amount of economic gain that organizations can make by using advanced analytical financial evaluation techniques like Real Options. Therefore, the given study has not only provided deep insights about the traditional financial evaluation techniques that manager's use, while making investment decisions in the given case company X but has also highlighted the several issues associated with the implementation of Real Options Valuation technique. By doing so, the given study has established a link between the academic fraternity and the industry.

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## **Annexure-1**

### **Interview Questions**

- **Part 1**

Q1. What is the procedure for selecting projects in the organization?

Q2. What are the various financial evaluation techniques that the organization uses for selecting projects, while making investments?

Q3. What are the various risks that the present financial evaluation technique takes into account at the beginning of the project?

Q4. What are the various issues that are not been addressed by the present financial evaluation technique used by the organization while selecting projects?

Q5. Does the present financial evaluation technique take into consideration the change in the risk profile of the project?

- **Part 2**

Q6. What are the various options that managers can exercise, while considering investments in the project life cycle?

Q7. How does the organization value the options that managers possess, does the value of these options taken into account while selecting projects?

Q8. What does the organization do, if the risk profile of the project changes during the project life cycle?

***-Obstacles Involved With Real Options Valuation Technique-***

Q 10. Based on the above subsequently crosschecking the following three roadblocks identified by Lander & Pinches (1998):

- I. Are you aware of the Real Options Valuation Technique? If YES,
- II. What are your views on the complex modelling assumptions required for evaluating projects using Real Options Valuation technique? If YES,
- III. How does the organization incorporate the additional assumptions required for mathematical tractability of the Real Options Valuation technique?

Q11. What are the reasons that Real Options Valuation technique has not been used in your organization as a financial evaluation technique for selecting projects?