

# Risk Analysis in Project Appraisal



# Risk Analysis in Project Appraisal:

*Assessment of Risk and Return  
in Capital Investment Decisions*

By

Savvakis C. Savvides

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## ABOUT THE AUTHOR



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## FOREWORD

*There are four key areas in a capital investment evaluation that make for a professional appraisal of risk and return. First, a sound methodology for an economic cost-benefit analysis of capital investment projects is a prerequisite for a comprehensive appraisal. There is consensus among academics and professional practitioners regarding the practice and application of an economic cost-benefit analysis in the appraisal of capital investment projects and in determining economic viability. Second, one further needs to use a sound and robust integrated financial model which correctly and prudently applies the methodology of cost-benefit analysis. Third, to structure the projection parts of such a model, one needs to do an analysis of the market and the competitive data to be projected in the appraisal. This phase, which unfortunately is not given enough attention in practice, is essential for projecting growth patterns of key variables in a consistent and coherent manner. A good and thoughtful strategic marketing analysis is also key for the fourth stage, which entails subjecting the financial projections to risk analysis using Monte Carlo Simulation methodology. Finally, the above analysis should lead to the derivation of the project's risk profile and how it may impact the various stakeholders and financiers of the project. This paves the way for an appropriate and fair agreement for a financing structure which shares the risks fairly among the stakeholders and apportions them to those that can best mitigate and manage them. This book addresses each of these aspects of a high-quality investment appraisal to enhance the capital investment decision.*

## ACKNOWLEDGMENTS

*Over my career, there have been many who have inspired, encouraged, and helped me along. I can only mention a few. First is Peter Spillard who was my professor at Lancaster University, while I was doing my Master's degree. Peter believed in me and advised me to explore my potential through hard work and by seeking and adopting the new. Another mentor in my life was John Joannides who as the General Manager of the Cyprus Development Bank, gave me a platform through which to develop my skills and competencies in assessing risk and return in the field. Professor Glenn P. Jenkins at Harvard University and later at Queen's University in Canada, was perhaps the one who has, like no other, worked with me for a period of nearly 40 years encouraging me to write and publish as well as to develop my risk analysis software. I would surely not have achieved much without having Glenn as an associate, colleague and last, but not least, friend. There are many others who have helped and inspired me along the way. Special mention should be made to Dr Graham Glenday of Harvard and later of Duke University with whom we have conceived together the conceptual foundations of what I have developed as RiskEase® Monte Carlo Simulation software.*

*I wish to thank my good friend Dr George M. Georgiou for edits and very helpful comments. Thanks, are also due to Marios Kourtellis for proofreading the manuscript. All errors are, of course, mine.*

## PREFACE

*This volume on Risk Analysis in Project Appraisal is a synthesis of the outstanding scientific and professional work undertaken by Savvakis C. Savvides over a period of forty years. It has been my privilege to have been able to discuss with him many of the ideas presented here on numerous occasions.*

*The book deals with the assessment of risk and return in capital investment and decisions and has as its focus the four fundamental analytical components of investment appraisal. They are: (1) the appropriate integrated financial model to use in undertaking such an appraisal; (2) the use of a formal market, or demand and supply, analysis to determine the need and competitiveness of the proposed project; (3) the steps one must take to prepare and analyse the results of a quantitative risk analysis using Monte Carlo simulation techniques; and (4) the analysis of the risk and returns for real investments particularly in project finance situations, which is then contrasted with the traditional analysis of the relationship between risk and return for financial assets.*

*This volume should be studied carefully by everyone engaged in the appraisal of real investments, and especially those interested in learning the fundamentals of project finance decision making. It is well grounded in economic fundamentals as well as the financial context in which such investment decisions are made.*

*Savvakis Savvides has been one of the modern-day pioneers in quantitative risk analysis of real investments. About 40 years ago he developed one of the first computer software packages for the quantitative analysis of risk using Monte Carlo simulations. This software has been continuously updated and today represents the state of the art in this field. His skills in finance, economics and quantitative risk analysis are reinforced by decades of practical experience from structuring successful project finance investments.*

*Several chapters in the book have circulated as working papers. He has used this opportunity to share and refine his ideas and recommendations with feedback from academics and professionals engaged in the appraisal of such projects.*

*This book is straight forward to read and is beautifully illustrated. It is both a textbook for those new to the field and a reference book for the practitioners. It can be highly recommended for both audiences.*

*Dr Glenn P. Jenkins, Professor of Economics Queen's University, Canada, and Institute Fellow Emeritus Harvard University.*

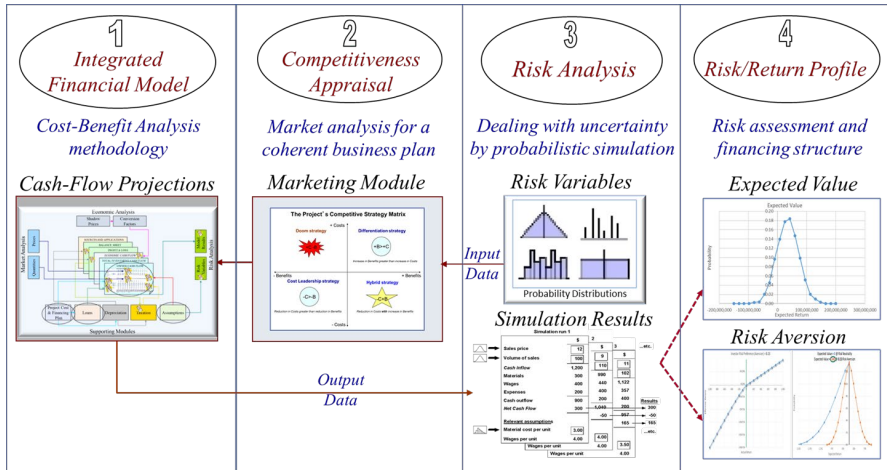
# I. Introduction

What I find intriguing, and at the same time rather challenging, is how we go about in trying to predict what may happen in the future. Professionally, I found myself having to make such assessments in the normal course of executing my duties, initially as an analyst and subsequently from various other posts with the Cyprus Development Bank, but also in other instances in my career where I was involved in the appraisal of risk and return in new capital investments and project finance ventures. I was also deeply involved with this in an academic capacity, mostly as a visiting lecturer at Harvard University and later at Queen's University in Canada.

I was lucky to have had exposure to this fascinating field from both academic and practitioner vantage points. This helped me keep focus on the application of the theory and at the same time to benefit immensely from the insights obtained in real life projects. My involvement in a professional capacity in project finance and credit risk assessment enabled me to constantly enhance and enrich my understanding of its theoretical foundations but also to methodically be seeking to develop practical ways and tools for better applying the theory. This has led me to become actively involved in software development and the publishing of computer applications by providing a platform for practitioners to apply these concepts and methodologies to assess risk and return in their field of activities.

Figure 1 outlines the book structure. As it happens, these are also the areas that I have had major contributions in this field for well over three decades. I published, taught, and most importantly practiced what I preached in many real projects as Head of Project Financing of the Cyprus Development Bank in all the areas and aspects of project finance. Although I do of course touch upon the methodology of cost-benefit analysis, as it is at the core of capital investment decisions, I have tried to focus on the parts that complement a good appraisal and the areas that I happened to have had a significant involvement in the field.

**Figure 1 - Evaluation of capital investment projects and the assessment of risk**



In the first section of the book, following a brief introduction of the methodology for applying the Monte Carlo methodology in investment appraisal, I present and discuss the *Integrated Financial Model* which fills the huge need for a reliable but simple and yet complete financial model for compiling and projecting pertinent cash flows, rather than a very detailed one as is the established practice by consultants and other practitioners. In addition, the need to deal effectively with the *correlation problem* arising during a simulation (as presented and discussed in Chapter IV) is mitigated and contained by using *growth pattern projections*. The few key parameters driving these consistent projections which can then be defined as risk variables in a Monte Carlo application.

When considering the past, the more detail one provides then often the better. This is because the past is cast in stone and exists as a certainty. But when projecting into the future, too much detail obstructs rather than aids our understanding of what is possible to happen. In my experience with the appraisal of many major project-finance ventures when consulting advice was sought, almost all ended up as examples where “*more is less*”. Especially where the detailed data thus gathered was not used as inputs to a simple but comprehensive financial model for projecting consistent scenarios. Taking a high-definition picture of the past is certainly not the best way to contemplate and evaluate what may happen in the future as regards a capital investment project. A simple but methodologically correct

integrated financial model is therefore imperative for a good and pertinent appraisal.

The second section complements and, most importantly, adds substance to the quantitative analysis of the financial model. It concerns the methodology for applying an appropriate market analysis and assessment of the competitive environment of the project. *It discusses* the key driving forces in the market the project is to operate and is vital in undertaking a meaningful strategic analysis. This is presented in chapter III on the *Market and Competitiveness Appraisal*. These neglected but important aspects of investment appraisal and the assessment of risk and return evolve around two papers I wrote and have taught extensively. These concepts have been published as Harvard Development Discussion papers, Savvakis (1988) and Savvakis (1990) and it is an area I studied well at university and have also practised in almost everything I was involved with in my professional career.

Chapter IV is about the actual application of *risk analysis* using the Monte Carlo Simulation methodology in investment appraisal projects. This section presents the methodology as published in my paper on “Risk Analysis in Investment Appraisal” in the late 1980s and published in the *Project Appraisal Journal* in 1994. The article was the conceptual background on which risk analysis software such as *RiskEase*® were developed to enable one to apply in simple and clear manner the Monte Carlo Simulation methodology in capital investment appraisal.

The last part of the book is on *what risk really is* (Chapter V) and how it may be measured and applied in capital investment and project finance decisions (Chapters V and VI). This is something I wanted to write about for a long time as many professors and colleagues with whom I have discussed the issue were not at ease in accepting that “*volatility*” is a good description or even an adequate measure of what is risk in capital investment. It proposes the uses of expected value and, more specifically, expected loss as a measure of risk and as outlined in the 1994 paper and applied through probabilistic appraisal using Monte Carlo simulation software. Further, through this methodology (and software such as *RiskEase*®) it is also possible to undertake risk aversion analysis and consider the capacity of a given project to meet and satisfy investor risk preferences.

Finally (Chapter VII and VIII) some actual case studies will be cited as specimens of how the concepts presented in the book may be applied in real

life project finance. These include an example of how this type of holistic and all-inclusive analysis may be applied in the evaluation of a guarantee in a Public-Private Partnership (PPP) concession agreement.

This book is an attempt to put forward the essence of what I have come to learn and understand through research and practice about how to assess risk and return and in making better capital investment and financing decisions.

### **Whose cash flows?**

Before one can attempt to answer the question regarding the need for economic evaluation for a capital investment project, it is imperative to ask first “*whose economic viability*”? No matter how well one tries to evaluate return and assess risk in a new capital investment, economic viability is and looks different from the perspective of the various stakeholders. In effect, cash-flows projected for the whole nation (the “*Economy’s*” perspective and adjusted to reflect economic prices) are different from those of the “*Owner*” of the project or from those of the “*Total Investment*” perspective where it assumed that the project is solely funded by equity and therefore does not include loans received (as inflows) and repaid (as outflows) in the projected cash flows (as is the structure of the projected cash flows from the Owner’s viewpoint).

There are several other cash flows that can be compiled and projected as they refer to various parties and stakeholders involved in a capital investment project. When one talks about the need for a new capital investment project to be economically viable, it is usually regarding a project evaluation from the economy’s perspective. This is a necessary but not sufficient condition for undertaking a public sector or a private-public-partnership (PPP). For such a project to be implemented the *Owner*, and often other *key stakeholders*, should also expect a positive risk and return profile. This is imperative before committing funds and other economic resources to a capital investment project.

### **Cost-Benefit Analysis and Economic Development**

The need for economic viability however is sometimes disregarded by politicians who are often keen not to have their pet projects subjected to independent appraisals, which may cause their rejection. Moreover, politicians, but also people generally, tend to confuse the inflow of funds into an economy with what is economic development. What they tend not



to appreciate is that it is not the funding but the actual *use of funds* that can bring about sustainable economic development and welfare. As pointed out by many economists, the uncontrolled inflow of money into an economy can result in making it worse off. The banks must position this money in the form of loans to generate an income from the accruing interest. A huge and abnormal inflow of deposits in a country simply encourages the banks to embark on collateral lending rather than through prudent assessment of viability and repayment capability. Politicians, lawyers, and many other intermediaries who benefit from having wealthy customers improperly argue that any investment is a good one and that the economy becomes better off by having funds injected into it (as deposits or in purchasing real estate). This, however, could not be any further from the truth. There are many examples where it drives an economy and its economic agents into an excessive and unsustainable debt burden (both private and public).

Economics is about using economic resources to maximise the welfare of a society. To move an economy closer to that optimum point of economic welfare, it is necessary to employ capital and labour and other factors of production such as land closer to their most efficient uses. However, to successfully accelerate the pace of economic development, in addition to increasing the levels of employment and attaining high efficiencies for the factors of economic production, it is also necessary to yield a good return on capital. This in effect means that a project scrutinised through a cost-benefit analysis test should have a positive net present value (where the projected net cash flow discounted at the opportunity cost of capital is greater than zero).

## **The assessment of risk and return in capital investment**

As mentioned above there are four key areas in a capital investment evaluation that make for a good and sound appraisal of risk and return, as illustrated in the Figure 1. The methodology of cost benefit analysis for capital investment projects is of course a prerequisite for a sound appraisal<sup>1</sup>. There is consensus regarding the practice and application of cost benefit analysis in the appraisal of capital investment projects and in determining economic viability. But although the correct methodology is necessary it is not always sufficient to facilitate the decision of whether to invest.

One further needs to have a sound and robust *integrated financial model* which correctly and prudently applies the methodology of cost-benefit

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<sup>1</sup> Harberger, Arnold C., and Glenn P. Jenkins 2000, Jenkins, G.P., 1998

analysis. Secondly, it is also fundamental to structure the projection parts of such a model only after first doing the serious homework on the market and competitive analysis data to be projected in the appraisal. This phase, which is not given sufficient attention in practice, is essential to reveal the driving parameters and to project growth patterns for key variables in a consistent and coherent manner. A good and thoughtful marketing analysis is also key when subjecting the financial projections to risk analysis using Monte Carlo Simulation. Last, but not least, the above analysis should lead to the derivation of the project's risk profile and how it may impact the various stakeholders and financiers of the project. This facilitates an appropriate agreement for a financing structure and for sharing of the risks among all stakeholders.

### **What is risk and can it be measured?**

But why do we even bother to assess risk and return one may ask? We surely cannot predict the future. Anyone that argues otherwise is either fooling himself or trying to sell you something. We cannot predict the future. Period! Be that as it may, there is an underlying need to make the best we can of what we may know or can gather to guide us in making a studied and better considered decision. And it is not a "Yes/No" decision either. The ability to model and understand risk and return often facilitates an improved formulation and leads to such arrangements to better deal with risks as these may arise during the life of the project. So, the purpose of going through a diligent and thoughtful appraisal of return and risk is to raise the metric of decision making and to understand risks as well as to better appreciate the competitive strengths (and weaknesses) of a proposed investment project. An enhanced understanding of the capital investment project and its risk and return profile even allows for a reformulation to make it more robust and better equipped to compete successfully in its targeted market. In addition, this process also facilitates the arrangement of an appropriate financing solution. Equity participation and debt exposure may therefore be adapted according to the ability of each party to manage and cope with specific project risks. Given appropriate expertise and software tools, such methodological scrutiny of new capital investment projects also contributes for a better allocation of resources and hence fosters economic development.

## Whose risk and whose return?

A question left relatively untouched in the application of economic analysis in capital investment projects is that which is usually referred to by Harberger (1971) as the *third postulate of Welfare Economics*. Simply put, it is assumed that economic value is the result of net present value of the costs and benefits in an economy *irrespective of who gains and who loses*. This is largely a useful assumption as it enables one to calculate the net effect of any given investment on a country without getting entangled into issues of inequality and subjective estimations of welfare. However, although it facilitates a generic project evaluation methodology it is a somewhat of an unrealistic assumption to assert that as long as the Economic net present value is positive one cannot question inequality aspects and transfers of wealth within the country. This assumption, as it will be demonstrated in the Motorway project sometimes results in the absurd conclusion that in a Public-Private Partnership project the tax-payer can pick up the bill for supporting a private entrepreneur with any amount as long as that particular capital investment project is deemed to have a positive net present value from the Economy's perspective. In its current state, the analysis extends to the point of constructing what is called as Stakeholder Analysis, see Jenkins, Koo, Harberger (1991). This is calculated and presented as supplementary to the core appraisal and shows how the Economic NPV is made up by indicating how various parties involved directly or indirectly in a capital investment project are assessed to be affected by it (who gains and who loses).

## The detachment of risk from return

Risk and return are the twin cylinders of the engine driving a free capitalist market. There is *no such thing as a return without risk*. Risk is simply the ambiguity that encompasses an entrepreneurial investment project as its future cash flows cannot be determined with certainty. Economic development is attained by *taking on risks* that are *part and parcel* of *productive capital investment* projects. Where risk is systematically detached from return the result is not *wealth creation* but rather *wealth extraction and transfer of assets*.

In the times we live in there are two key words people understand and very often interpret wrongly. The word "*investment*" and the word "*risk*". Funding and earning a return (rent) does not necessarily constitute a productive investment that builds up the real economy. To add to the

existing welfare of a society the project should be economically viable. If it does not fulfil these conditions often it leads to a transfer of existing assets (frequently real property) and may be better described as wealth extraction. The total assets in the economy do not change; only the ownership does. In the times we live in, this is further facilitated by a loose world financial market and a failing banking system whereby banks provide on-balance sheet loans, or better known as collateral lending, without a proper assessment of repayment capability (Savvides 2019).

The second big fallacy in finance is what investment risk is really and how it may be evaluated and measured. It is not volatility of stocks but rather the probability weighted negative return (expected loss) that is undertaken by various stakeholders in a capital investment project. This is taken up in detail in the section on “Risk and return Revisited (risk through the looking glass)” later in this book (Savvides 2022b).

## II. The Integrated Financial Model

Understanding and mastering the correct cost-benefit methodology and applying Monte Carlo simulation is a necessary but not a sufficient condition for a proper and sound appraisal of risk and return of a capital investment project. The methodology, if applied correctly, will allow one to include and formulate the correct variables and thereby to draw the correct inferences and conclusions regarding the message they may convey. But by itself, this is rarely enough or adequate for the appraisal of risk and return.

When one is confronted with a decision about the future, projecting in a similar manner as we account for the past by gathering as much detail as we can is not an advantage. Quite the contrary in fact. When considering how a business plan may evolve one can only hope that as the future unfolds it will be close to what was assumed in the projections. But, unlike the past, as the future reveals itself, we can always adapt our actions and policies along the way to better manage some of the risks and how these may affect the outcome of a given project. This is why we apply probabilistic analysis to a base case projection using the Monte Carlo simulation methodology. Monte Carlo simulation is a methodology that allows us to map, or sketch out, the spectrum of possibilities of what it is reasonable to expect based on the probabilistic assumptions made in a projected financial model. What we expect is that the analysis will enable us to better understand and gauge the impact of specific risks that stakeholders and financiers involved in a capital investment project may be called to undertake.

To achieve this, we do not need a complex financial model and to gather every detail from the past to forecast the possible outcomes for evaluating a given project. This, in any case, is not why an appraisal of risk and return is undertaken. We do not try to predict or even guess the future. We look and analyse the past only to the extent that it enables us to understand how factors that relate to our specific project work and then use this knowledge to create a simplified but elaborate enough model to help us take prudent risk mitigation and management as well as investment financing decisions. Though a thoughtful and correctly applied probabilistic analysis in the evaluation of risk and return we enhance and raise the metric of decision making in undertaking and funding capital investments.

To facilitate this process, it is useful to have available a well-tested integrated financial model which applies the correct cost-benefit analysis.

One such adaptable, coherent, and easy to use financial model is the Integrated Financial Model<sup>®</sup> by *Savvakis C. Savvides*. This was created and tested after many years of expertise of the author in project finance and corporate lending appraisals as well as from teaching and writing about the subject, including the development of several related software. The model is designed so that it offers the user the following benefits:

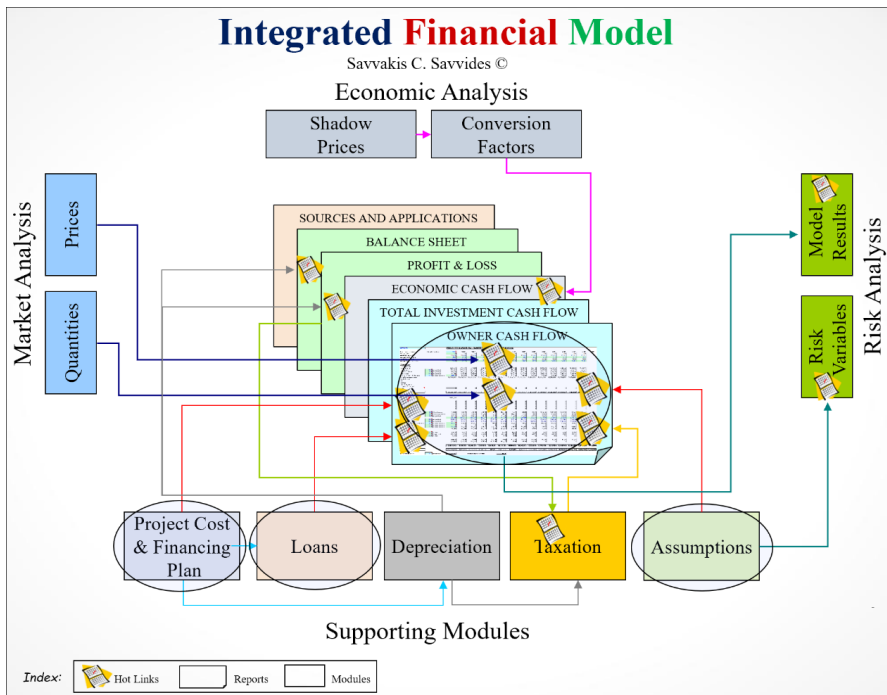
1. To be set up easily and quickly.
2. To be coherent and comprehensive.
3. To be adaptable with very few changes.
4. To be usable for any type or size of project.
5. To be well and truly integrated.
6. To be driven by a manageable number of important parameters and to include and accommodate the simple use of a specially designed forecasting Excel Add-In which allows the easy and coherent projections of growth patterns.
7. To be ready for Risk Analysis using Monte Carlo simulation software (see RiskEase in Appendix).
8. To produce reports of financial cash flow projections from the perspective of various stakeholders, including the owner of the project, the total investment perspective or and to be easily expandable so as application of economic analysis.
9. The Model can also be quickly set up to be used for screening promising or to discard poor and non-viable projects.
10. Last, but not least, the model can be attached as a front end to very large and elaborate workbooks to make sense of their useful, but often not so well integrated, content of data.

The Integrated Financial Model (IFM) was built to enable the sound and reliable appraisal and funding of proposed capital investment projects. The norm before the creation of the IFM was to construct from scratch basically a new financial model containing all the details and data of the project at hand. There were two problems with this approach: it takes a long time to prepare and even longer to have it audited and tested so that it could be relied on to base such serious decisions.

Armed with the experience of many such endeavours and with the knowledge gathered relating to what would constitute a reliable tool for undertaking a risk and return analysis an adaptable but reliable model was built. This was constantly improved and enhanced with every new project. The IFM is rather unique for two reasons. The first is that it is both simple and comprehensive. It does cover all aspects of a cost-benefit application and

produces all the required reports. The second which is equally, if not more important, relates to the word “integrated” as it is driven only by the few key parameters that are entered by the user. It is possible to set up the Project Cost and Financing Plan quickly and easily (a requirement for any capital investment project assessment), enter any existing or completely new project with all the settings required, add some key parameters in the Assumptions sheet and prepare it for using a Growth Patterns Projection template to project forecasts and then link the results to the Cash flow Owner sheet and so on. The IFM builds up a picture of what the project is sketching out to be and as soon as all the parameters are set all the reports are ready (as illustrated in Figure 2).

**Figure 2 - The Integrated Financial Model**



A third and very important aspect of the IFM is that it is risk analysis ready. It is imperative to have such an integrated financial model in place and one that is driven by a few key parameters ready to apply on a meaningful risk analysis using the Monte Carlo simulation methodology. The IFM is a very sophisticated engine under the hood but also one that is rather simple to use.

But one can get an appreciation of how it is employed to enhance the understanding of risk and return from the examples presented.

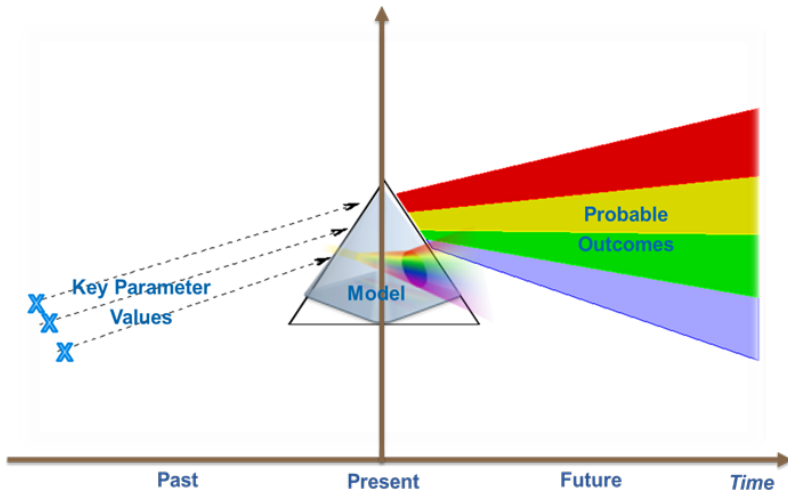
As mentioned above, the more detail we provide when looking into the past the clearer the picture becomes. This is what accountants do in fact when they gather data and compile a historical account. However, when looking forward into what may happen in the future more detail is not always better. This is because the future has not happened yet. As obvious as this may sound, in practice experts and consultants often provide as much detail as possible usually by gathering and putting together in a complex and sophisticated spreadsheet a collection of data assembled from various historical sources. Such as past records of a company or its competitors, quantities and prices for many similar products, market shares and even detailed descriptions of markets by regions and types of customers or supplier. In fact, they approach the future the same way an accountant would record, construe, and then report the historical past.

Contrary to general belief the future cannot be predicted. What may be forthcoming, at best, can only be better understood and appreciated. It cannot be reported or accounted for the way we look at the past because it has not happened yet. But there is a huge upside. While you cannot change one iota of the past one can learn and adapt and adjust what may happen to a project in the future. As illustrated in Figure 3 by identifying and projecting the key parameters through the prism of a reliable financial model we may reveal a blurred spectrum of how the future may unfold. This at best can only be understood probabilistically. Possible outcomes are weighed against their probabilities within a Monte Carlo simulation framework.

The assessment of what can be expected from a proposed capital investment is therefore always in terms of expected value of return. The sum of negative returns (below 0 NPV) in a simulation multiplied by their probabilities is what we term as Expected Loss from the investment while the positive returns (above 0 NPV) multiplied by their respective probabilities make up the Expected Gain from the investment. Risk is not “volatility” as perceived by someone on the floor of a Stock Exchange but rather the probability weighted expected returns. The “expected loss” and “expected gain” concepts together make up the expected value of return of the project as whole.



**Figure 3 - Risk through the prism of a financial model subjected to simulation**



There is a huge gap between how practitioners in general apply the cost benefit methodology focusing on too much detail and not *the substance* in appraising a capital investment. The mistake is to try to picture the future in every detail as one would when looking at the historical past. Rather than enhancing the understanding of what drives a project and how it may be successful in a competitive market environment, such an approach only succeeds in adding to the confusion and it is a poor base on which one can pertinently make thoughtful and sound capital investment decisions about risk and return.

### **The future is by its nature uncertain**

If there is something we know for certain is that there is nothing certain regarding the future. We simply cannot foresee the future. There is no crystal ball that can show us even a mere glimpse of what will take place at some time in the future. The future is by definition probabilistic. The appraisal of any future project at best can only enhance our understanding of what we may reasonably expect from as the future unfolds and how it may affect our plans. We can only learn from the past to gain a good idea of what we may expect to happen if we repeat such actions at a future time. But in an ever-changing world even that is not a given. And yet, we continue

to project our assumptions for a given business plan as if we expect them to take place with absolute certainty. Moreover, we also take as given that the outcomes of a projected financial model will be as thus calculated. In effect, however, whether we realise this or not, we attach to each projected input in a financial model a single-value probability distribution. In other words, we presume that all we project will happen with 100% probability and with no possible deviation. This is why the outcomes projected are also deterministic and presented as certainties. In effect this means that if we were to use Monte Carlo simulation methodology to run probabilistic scenarios using this certainty equivalent single-value probability distributions for each risk variable, the scenarios generated will all be identical and the same.

We can obviously improve our understanding of risk and what may happen in the future of any such financial model of a projected business plan by relaxing the single-value probability certainty equivalent assumption for those parameters we consider to be risk variables. The result is, of course, that we end up with multi-value probability distributions for the outcomes in the projected model which is subjected to Monte Carlo simulation.

A Monte Carlo simulation can, and sadly sometimes is, used a mechanical rather than in a manner through which to gain a better understanding of a given project. One that merely gazes at the results arrived at from any of the two approaches possible will hardly be able to tell the difference. Hence, the need to research and write about how to use Monte Carlo simulation risk analysis so that the application of the methodology truly enhances one's understanding of the project and helps make better capital investment decisions.

The assessment of risk and return in capital investment entails more than just the projection of single value expected revenues and costs. One needs to be applying the correct cost-benefit analysis methodology but also to employ an integrated financial model ([1] in Figure 1) where the details take second place to the competitive strategy of the project in its defined relevant market and targeted customers. This is done through a coherent competitiveness appraisal ([2] in Figure 1). The integrated financial model is also a necessary condition for projecting and maintaining consistency in one's assumptions when switching from the deterministic base value case to the probabilistic multi-value risk variables in the context of a Monte Carlo simulation process ([3] in Figure 1). Finally, one needs to assess risk in the correct context of expected value ([4] in Figure 1) rather than in the historical volatility measures that are typically gathered and viewed from the floor of