The Practitioner's Introduction to the Concepts and Practices of

Project Financial Analysis

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List of Spreadsheets utilized in the text and videos:

Workbook 1: Project_Finance_Video_Spreadsheet_Compilation.xls.

Description: This workbook contains the videos utilized in the creation of the videos

Sequential workbook tabs:

V2.1_Static_vs_Dynamic
V2.2_Discounting_Future_Values
V4.1_Project_NPV_Calculations
V4.2_IRR using Goal Seek
Project NPV Evaluation Template
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Description: This workbook contains the videos utilized in the text in addition to useful templates for carrying out common tasks

Sequential workbook tabs:

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Tornado Diagram Template
WACC Calculation Template
WACC_Industry Averages 2022

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Description: This chapters presents a template for organizing publicly-available financial data utilizing Accenture (ticker: ACN) data as an example.

Sequential Tabs:

- ACN FCF Model
- ACN Income Statement
- ACN Balance Sheet
- ACN Cash Flow

CHAPTER 1: INTRODUCTION

Structure of this book

This book an introduction to the philosophy and mechanics of performing financial analyses on projects. This material is designed for the practitioner interested in learning the art and techniques of financially assessing a project. That practitioner may be a university student just learning the art or an employee desiring to assist their organization in making better, informed evidenced-based decisions. The book extends beyond the topic's conceptual introduction by providing "how to" details that will allow the novice to advance from little understanding of financial analysis to being able to perform the tasks necessary to fully assess the financial impact of proposed projects. This is accomplished by providing detailed examples, via this text and associated videos and spreadsheets, that illustrate how to build complex financial models overlaid with sensitivity analyses.

Project management decisions hinge on an understanding of the project's financial impact on the organization. That understanding must also be communicated to the organization's decision-makers in a way that the insight gained from the analysis can be properly utilized. No project analysis is complete until its findings are communicated to the organization's decision-makers. Given that the analyst is typically not the organization's decision-maker, the topics of this book extends from the creation of the financial models to instruction on communicating the results of the analysis in a clear, concise, direct actionable and fact-based report.

The teachings of this "book" are not limited to the text and graphics on the pages of this document. The entire "book" is considered the integration of this text with two important companion pieces: videos and Excel® documents. There are eight videos (see list below, Figure 1.1) that are referenced throughout this book. These videos provide step-by-step instruction using Excel® to perform various financial assessment tasks.

V2.1 Static Vs. Dynamic Spreadsheets
V2.2 Discounting Future Values
V4.1 Project NPV Calculations
V4.2 IRR using Goal Seek
V5.1 Project Finical Model Building
V6.1 Tornado Diagram Input Table
V6.2 Tornado Diagram Graphic Creation
V6.3 Project Success Conditions

Figure 1.1. List of Videos that integrate with this written document

All of the spreadsheets used in the videos, all the spreadsheets presented in the text, plus a number of templates that are useful as starting points for financially assessing projects are included in the second companion piece. These individual worksheets are organized into three Excel ® workbooks. The first workbook, "Project_Finance_Video_Spreadsheet_Compilation.xls," includes all the spreadsheets utilized in all the videos plus a couple of generic templates. The inclusion of these spreadsheets allows the reader to gain skills by working in in Excel® in parallel with the video descriptions. The sequential tabs of that workbook are:

V2.1_Static_vs_Dynamic
V2.2_Discounting_Future_Values
V4.1_Project_NPV_Calculations
V4.2_IRR using Goal Seek
Project NPV Evaluation Template
Project Description
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V6.1_Tornado_Diagram Input
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V6.2_Tornado_Diagram_Graphic
V6.3_Success_Conditions

The second Excel® workbook, "Project_Finance_Chapter_Spreadsheets_&_Templates.xls," includes spreadsheets that appear in this text as well as templates utilized as a starting place for some of the tasks described. The sequential tabs of that workbook are:

Chapter 2
Chapter 4
Project NPV Evaluation Template
Tornado Diagram Template
WACC Calculation Template
WACC_Industry Averages 2022

The third workbook entitled "ACN_Free_Cash_Flow_Model_Data_0422.xls" contains information for Chapter 3. The first tab of this Excel® workbook is a generic free cash flow model template that can be utilized with any downloadable income statement, balance sheet, and statement for any firm. The workbook provides an example of mapping publicly-available data to this generic free-cash-flow template using data for Accenture (ACN, 2022). The sequential tabs of this workbook are:

ACN FCF Model
ACN Income Statement
ACN Balance Sheet
ACN Cash Flow

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Project Valuation Context

Project finance, or in other words, the financial evaluation and/or assessment of projects, is but one aspect of corporate finance. Like all financial analyses, it is built upon the development of prior financial skills.

Figure 1.2 is an illustration of the financial skill-set development that is foundational, to being able to perform project financial evaluations. Figure 1.2 illustrates this cumulative skill-development as ascending a flight of stairs. There is no elevator that will drop us off at the top of the project financial assessment staircase. We must climb there. Skimp on understanding any of these foundational elements and you will find yourself, at some point, losing your footing and sliding down the staircase before reaching its apex. In other words, the content that leads to project financial analysis is cumulative and builds upon the step that preceded it.

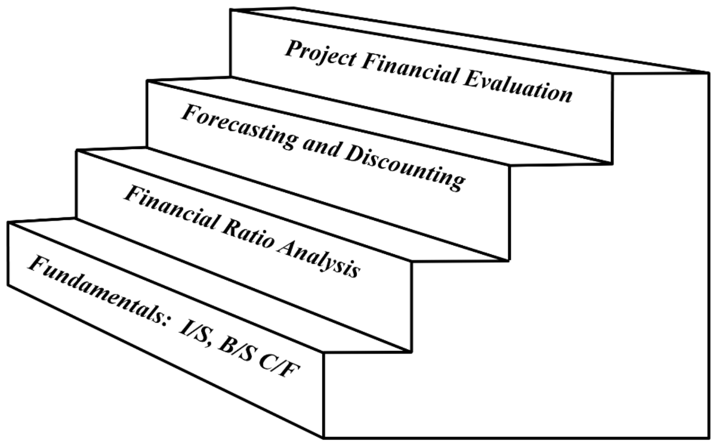

Figure 1.2. Foundational Element Staircase leading to Project Financial Evaluation Skills

Project Financial Analysis Introduction

Project Good decisions are made based on good judgment. Good judgement, as they say, is often based on our prior poor decisions. But what if we could improve our judgement in a less 'painful' manner, by "seeing" the impact of mistakes before we make them? What if we could gain that insight by seeing things most others cannot. What if we could then leverage that insight to make better decisions? Wouldn't it be great to have that kind of "vision" that allowed us to insightfully see what most others cannot? Imagine how valuable we would be to ourselves and to our employers. Imagine the contribution we could make – the impact we could have – if we had such a 'gift.'

Beyond that, every employee of any organization is obligated to perform ethically. Included in those ethical standards is being "fiduciarily responsible" (Peppers, 2014). Pepper defines fiduciary responsibility this way:

> "Fiduciary Responsibilities. We rarely act alone, but usually as members of organizations. As business people, we have an ethical duty to further the interests of our employers and shareholders. No one has the right to impose his own personal moral views on the actions of the company he works for – unless he owns 100% of the company himself."

What if we could simultaneously be fiduciarily responsible to our organization AND help that organization improve its judgement in making decisions? That is the potential power that project financial assessment holds.

Every organization has "projects." These projects that the company initiatives are intended to improve some aspect of the organization. There are lots of "ideas" floating around any organization that could be executed, but which should the organization actually do? No organization has the time, people or resources to act on every idea. Which ones should they choose to do? How would they prioritize them? Based on the charisma of the project champion? Oh, no! Rather, wouldn't it be advantageous to be able to peer into the future and "see" which projects would most benefit the organization? If you had such ability, you could travel into the future, assess the impact of the project, and then travel back to the choose the projects that created the most impact. What a great "super-power" that would be to possess! But that super-power is neither mystical nor unattainable. It is also not an innate 'gift' bestowed on the precious few. It is a learnable skill. It is called project financial analysis or assessment, which can be developed through the teachings of this book.

Example

Let's say that you work for a specialty chemical company with annual revenues of $50 million. That firm is seeking to expand. Since the firm is currently selling everything it can currently produce, it must expand production capacity in order to increase sales. The sales people are clamoring for additional product to sell (not surprisingly as a portion of their pay is tied to sales commissions). The production group is lobbying for the same thing (bigger is better and more prestigious in their world, after all). As a result, what is being proposed is a production expansion project. This capital project is estimated to cost $4.75 million, according to the engineering study. But is this a good move for the firm? Is this a viable financial project for the firm? Would the company be better off investing that money in other aspects of the company?

The expansion project *feels* like a good idea. Of course we would want to make sure the project runs on-time and on-budget. But that's not nearly good enough to make a nearly $5million dollar decision. Your "gut feel" is simply not enough to make a $5 million decision, regardless of your level of experience. In addition, beyond the project's "go" or "no go" decision, we would like to know the project's risks before we begin. Yes, everything is risky, but we need more specifics. What elements of the projects are crucial to its success? Where should the firm be focusing its managerial attention? The company needs real insight, not just a vague "sense" of what should be done. Insight that can only be derived from thorough analysis. But what analysis? And how do you communicate the results of that analysis in a way the decision-makers can comprehend and make informed, fact-based decisions versus "gut feel" ones?

This example will be assessed in detail in Chapters 5 and 6. Chapter 7 will then provide an example report to communicate the findings of this analysis to busy executives.

Analysis Approach: QMCR[3]

There is a lot we want to know about the aforementioned project, so where do we even begin? To make things more complicated, every project will have its own nuances, its own subtleties that are associated with it. Fortunately, there is a general approach that can be applied to all projects. An approach that will allow us to provide the insight we need to properly evaluate the risks and rewards of any project. While the details of every project may be different, the general approach can be the same. There may exist a a variety of approaches that could work, but the general approach that will utilized throughout this text is described by the mnemonic QMCR^3: Question, Measure, Calculate, then Recommendation, Risk, Relevant context.

- **Q**: What **Q**uestion are we trying to answer?
    - In the example presented the question is straight-forward: do we move forward with this expansion plan or not? No question, however, is quite that simple. The real question is under what conditions should this project be forwarded?
- **M**: The second issue is what **M**easure will be utilized to address this issue?
    - There may be more than one potential measure, but if a specific measure is not determined up-front, then anyone can rationalize a decision based on pretty much any measurement that fits their position. That is the opposite of data-informed leadership. That is leadership by data-manipulation and is just a phantom version of "gut-feel" leadership. In this example, there are lots of options. Do we simply go by the say-so of our trusted advisory board? The majority vote wins? (Massive gut-feel, versus single-data-point gut-feel management?) Probably not. Do we look at how the move impacts the overall company valuation? That may be understandable if we are a public company and our compensation is partially based on the company's stock price. A better measure would be would be to directly determine the potential value of the project itself. Does the project add-value to the firm or not? Over what period of time? If we are looking over time, then we must take into account how the value/cost of money of the organization over time. In addition, the money the firm spends on this project likely means that it has less to spend on other projects. Is this project financially better than the other projects under consideration? Ideally, we would like a measure that would put all projects on a financial level playing field. These measures will be discussed in detail in Chapter 4.
- **C**: After we know what we are going to measure to judge the outcome of our decision, we will need to determine how to **C**alculate those measures. Chapter 4 will also provide those details.
- **R^3**
    - **R**: **R**ecommendation? What is our recommendation for moving forward? Explain this recommendation in plain ENGLISH, not jargon or numbers. What is the basis for the recommendation? Reporting the results of the analyses is covered in Chapter 7.
    - **R**: What are the **R**isks? Any recommendation that is made must be accompanied with a description of the project's risks. They need to be specific. What does management need to focus on to make this project financially successful? What are the successful bounds of the project? In other words, what are the conditions that will allow this project to be financially successful? Remember, the analysis is are not being performed in order to find some singular numerical "answer," it is insight that is being sought. Insight comes from "what if" analyses.
    - **R**: **R**elative context, if any. Is there context – background or history—that will help the decision-maker? Has the organization done this type of thing before or does it require the setting of some sort of hitherto unattainable new world record?

Communication Approach

The above is the general approach to analyzing any project. Communicating the results of the analysis to decision-makers is an entirely separate issue. Bosses tend to be very busy, meaning that the analysis should be delivered in a concise and actionable fashion. Knowing and not communicating what one knows is the same as not knowing. If the analysis, for example, revealed major project risks yet we were unable to communicate those risks in a manner comprehensible to decision-makers, then the result is equivalent to our not knowing the risks at all.

Any project's complete financial analyses, including the sensitivity analysis that may have been done, will take some serious effort. Impressive insights will be gained as a result of that effort. But all that will be for naught if the findings are not communicated in a manner that creates impact for our organization. That means we need to communicate the findings of the detailed analysis in as simple a way possible. Knowing how to properly report the results of an analysis is as important as doing the analysis. An entire section of this document, Chapter 7, is dedicated to report-writing. For now, the general approach of writing such reports will be outlined.

Financial Analysis Report:

1. Background
   Remind the reader what the company issue is (be sensitive to the fact that they are juggling many balls). Put in any important-to-know background here, but be BRIEF. You can explain details later in the report, but here you are just reminding the reader of the issues and its context.

2. What's the recommendation?
   What action are you proposing? You are not writing a mystery novel that will "reveal" the recommendation at the end, put it up-front! The remainder of the report will support this recommendation, but say it first, then justify your position. This is the opposite of how you arrived at this conclusion, of course, but the report is not a chronology of your analysis.

3. Analysis Overview
   a. What's the recommendation based upon?
      What did you **M**easure? How does it compare to alternatives? (Don't forget that "doing nothing" is an alternative.) What significant assumptions were made in this analysis? Don't get bogged down in all the details of your calculations here, but do point out the important underlying assumptions made in your analysis (particularly if they relate to the risks you uncovered.)

   b. What are the key risks that would subvert the success of this project?
      All projects have risks and unknowns. Some are critical to the project's economic viability and others are less so. Good managers focus on the significant issues and don't get mired with the trivial ones. But they first have to know which is which. Again, a good financial analysis can greatly improve on "gut feel." Simply stating that a project is "risky" is not really helpful. To manage the risks -- you need to know "HOW" it is risky? What elements of the project most significantly determine the project's financial success?

Only after these risks have been identified can you make recommendations on how to mitigate those risks.

Appendixes

a. The main body of a report should definitely not be 1000-page tome, but brief decision-making guide. The specific details of your approach to assessing this project, that may be important for historic reasons or for others to perform similar analysis, should definitely *not* be in the main body of the report. Those details will be captured in the appendices of a final report. The body should include the overview of the approach you took, but the methods utilized in calculating those values are saved for the appendixes. Even still, the "how" that is included in the report is **not** the minute details of the calculations… not an explanation of "cell B6 times C34" or even "used Excel's 'goal-seek' function to…." No. the "how" is greater detail of the *approach* you took to that lead to the insight. You calculated a 10-year NPV at the company discount rate, etc. You performed a sensitivity analysis across 7 different input-variables. What did you assume for upper and lower limits for each of these variables? How were these boundary conditions determined? Remember, you want to present enough information in the body of the report to allow the decision-makers to make a data-based decision. The details of what you did will be in the appendix of a final report in case someone else has to go back and revisit and/or update this analysis in the future. (It is good to keep in mind that that *you* may be that future analyst, so do your future self a favor by providing enough detail in the appendices that would allow you to re-do the calculations a year or more from the time you did them originally.) A "final" project report can also include screen-shots of the excel models in the appendices.

Chapter 7 will present an example report for a fictious project that was assessed in Chapters 5 and 6.

Remaining Book Context

As mentioned, the content of this book is delivered as a combination of the text of this document, the associated videos listed in Figure 1.1 and the worksheets included in the previously-mentioned Excel® workbooks. The videos and spreadsheets will provide step-by-step instruction so you can develop your actual analysis skills, not just your understanding of that theoretical construct.

Below is an outline of the remaining chapters of this document. Sections that contain related Excel-based videos are noted with a "V." Those videos, and the spreadsheets utilized in those videos, will be specifically called out at the appropriate point in each of those chapters.

- Chapter 2: Project Financial Analysis Background (**V**)
  This chapter provides some mathematical and analysis background that may or may not be familiar to the burgeoning financial analyst. This chapter can be skipped by those already familiar with the concepts provided
  - Mathematics of Change

  - Present Value of Future Cash
    - Components of future cash value changes
    - Corporate WACC
    - Calculating the Present Value of Future Cash Flows
    - Discounting at a Project Hurdle Rate
  - Static versus Dynamic Spreadsheets
  - Chapter Summary

- Chapter 3: Financial Statements
  This chapter provides background on an organization's financial statements and how these concepts are utilized in performing project analyses. Readers familiar with these statements can skip this chapter.
  - Income Statement
    - Direct Costs
      - COGS: Cost of Goods Sold
      - Depreciation and Amortization
      - Teasing our COGS from Cost of Revenue
    - Indirect Costs
    - EBITDA
    - Common Sizing
  - Balance Sheet
    - Working Capital
  - Statement of Cash Flows
    - Sources and Uses of Cash
    - Cash Flow Activities

- Chapter 4: Project Financial Measures (**V**)
  This chapter describes the measures that are generally utilized to financially assess projects. Beginning in Chapter 5, these measures will be applied to the example introduced in this chapter.
  - Question(s)
  - Measure(s)
    - Present and Future Values
      - Project Measure Values: DCF, NPV and IRR (an introduction)
  - Calculation(s): DCF, NPV and IRR
    - Calculation Overview: Cumulative DCF, NPV and IRR
  - Chapter Summary

- Chapter 5: Project Financial Model Building (**V**)
  This chapter begins the detailed analysis of an example project. The project that was introduced in this chapter will be detailed and assessed beginning in this chapter. The details of this example will be carried through Chapters 6 and 7.
  - Example
    - Discount Rate
    - Invested Capital
    - Revenue
    - Operating Costs

        - Completed Dynamic NPV Project Analysis Spreadsheet
    - Chapter Summary

- Chapter 6: Project Sensitivity Analysis (**V**)
  This chapter will perform the sensitivity analyses required to understand "under what conditions" this project is financially viable. The aim is not to determine a single base-case project value, but to gain insight into the implementation of this project. That insight is obtained by carrying out the sensitivity analysis of this chapter. In addition, this chapter introduces the "Tornado Diagram" which is a visual means to communicate the results of the sensitivity analysis.
    - Example
        - Project Tornado Diagram Development
            - Input Variable Ranges
            - Variable Impact on 10-Year NPV
            - Tornado Diagram Graphic
            - Deeper Dive
    - Chapter Summary

- Chapter 7: Project Financial Report
  Communicating results in in a manner that is clear, concise, direct, fact-based and actionable is critical (and too often overlooked) element of the analysis. This report continues the example project of the last two chapters by creating a mock report of the financial assessment of that hypothetical project.
    - QMCR^3
    - Report
        - Audience
        - Report Document
            - Report Outline
    - Final Report Thoughts
    - Example Report
        - Background
        - Conclusion and Recommendations
        - Analysis Overview
        - Appendices

- Chapter 8: Book Summary
  This chapter wraps up the learnings of this book.

CHAPTER 2: PROJECT FINANCIAL ANALYSIS BACKGROUND

Corporate finance, in general, is focused on two things: the future and change. Is the anticipated revenue for next year expected to increase or decrease? Why? What is the projected impact of the proposed new cost-control policies? How much will the costs be expected to change? Why? A good financial analysis must also be capable of responding to any number of "what if" questions. This is what we expect will happen in the future, but "what if" this changes or "what if" that changes? What is the potential consequence of those changes?

This chapter will provide background on the mathematics of change, the basics of determining today's value of tomorrow's cash and how to create dynamic versus static spreadsheets. Some of you may have this background already. That's great. If that is the case, you can skim over this chapter or skip it altogether. For those less familiar, this is meant as a cursory review. This will not replace the foundational steps that are needed, as shown in Figure 1.1 of the last chapter, that lead to accumulate to the skillset required to perform project financial evaluations. Instead, this section is meant to provide a review of the main relevant elements of those foundational steps.

The Mathematics of Change

<u>Relative Values</u>

All change is relative. In any financial analysis, we are looking for *relative* change. Costs are dependent on the amount of product produced, and revenue is based on the amount of product sold. That makes costs and revenue related. Tracking an absolute value – a dollar value – for the organization's costs over time does not provide very clear insight if our revenue is also changing over the period we are assessing. Even projected future revenue is relative to current revenue… let me explain. For example, let's say we are hoping for a constant increase in revenue over time. Our current revenue is $1000 in Period 0 (today). If we increase revenue by $100 every future period, then it appears as if we are growing steadily, right? It certainly appears so in the Excel scatter-chart of Figure 2.1. The $-value of the growth increases steadily and actually doubles to $2000 by period 10. (Those "periods" could be "years" or "months" or "quarters," it does not really matter in this example.)

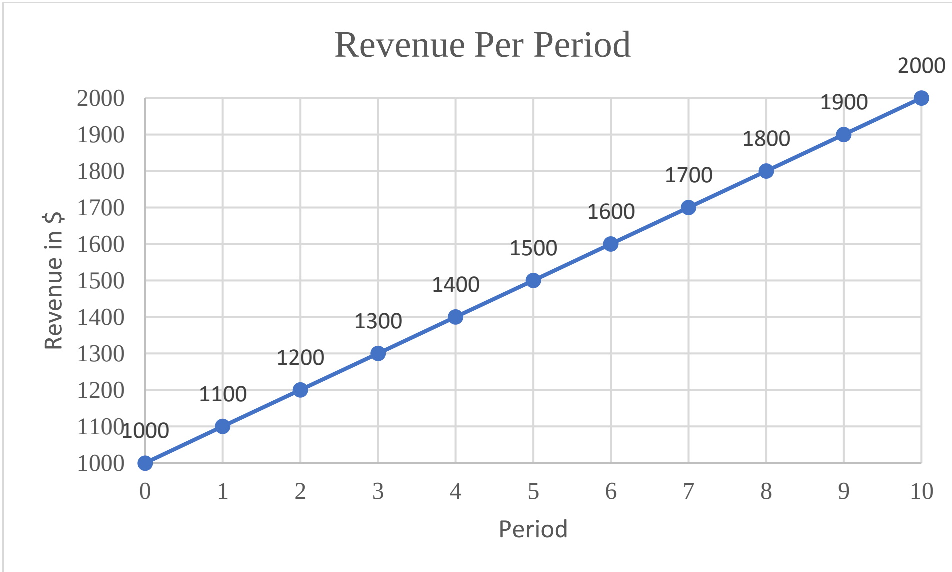

Figure 2.1. Constant Dollar-value Revenue Growth

But the *relative* growth of income is <u>not</u> steady. In fact, the relative revenue grow is gradually *declining* over time, although that is impossible to see that by looking at Figure 2.1. *Relative* change is the change in relation to the starting value. Gross change is measured as “final” value less the “initial” value. Relative change is “final” value less the “initial” value and that difference divided by the “initial” value. (Note that the change can be positive or negative value.) Let’s look at the algebra of change to see this more clearly.

For any period “i” the next period is “i+1”. If “i” represents the 7th period, for example, then “i+1” is the next or 8th period. Using this nomenclature:

$$\text{Relative Change in Revenue} = \frac{[\text{Revenue in Period (i+1)}] - [\text{Revenue in Period (i)}]}{\text{Revenue in Period (i)}} \qquad \text{Eq (2.1)}$$

Or more generally:

$$\text{Relative Change} = \frac{Ending\ (or\ \text{"final"})\ Value - Initial\ Value}{Initial\ Value} \qquad \text{Eq (2.2)}$$

The relative change is therefore expressed a fractional improvement (or decrease) of the initial value. It can also be expressed as a per cent of the initial value. Let’s look at the change from period 1 to 2 in our example. The starting or initial value is $1000 and the final value is $1100. The change (increase in this case) is $100 ($1100-$1000). Plugging our example numbers into Equation 2.2 yields:

$$\text{Relative change} = \frac{Final\ Value - Initial\ Value}{Initial\ Value} = \frac{1100-1000}{1000} = \frac{100}{1000} = 0.10$$

This relative change is 0.1 times the initial value or 10% of the initial value

Now let's look at the relative change in Revenue in our example from Period 9 to Period 10. The $-change in revenue is still $100, but the starting value of our relative change measurement, the revenue for Period 9, is now $1900. Again, plugging these values into Equation 2.2 yields:

$$\text{Relative change} = \frac{Final\ Value - Initial\ Value}{Initial\ Value} = \frac{2000-1900}{1900} = \frac{100}{1900} = 0.0526 = 5.26\%$$

In fact, if we examine the relative change in revenue over the entire 10 periods, we can see (scatter-chart Figure 2.2) that the relative revenue growth is slowly DECLINING over time from 10% to 5.3%.

Periods	0	1	2	3	4	5	6	7	8	9	10
Revenue	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000
Revenue Increase	xx	100	100	100	100	100	100	100	100	100	100
% Change in Revenue:	xx	10.0%	9.1%	8.3%	7.7%	7.1%	6.7%	6.3%	5.9%	5.6%	5.3%

Table 2.1. Relative Revenue Change Over Time

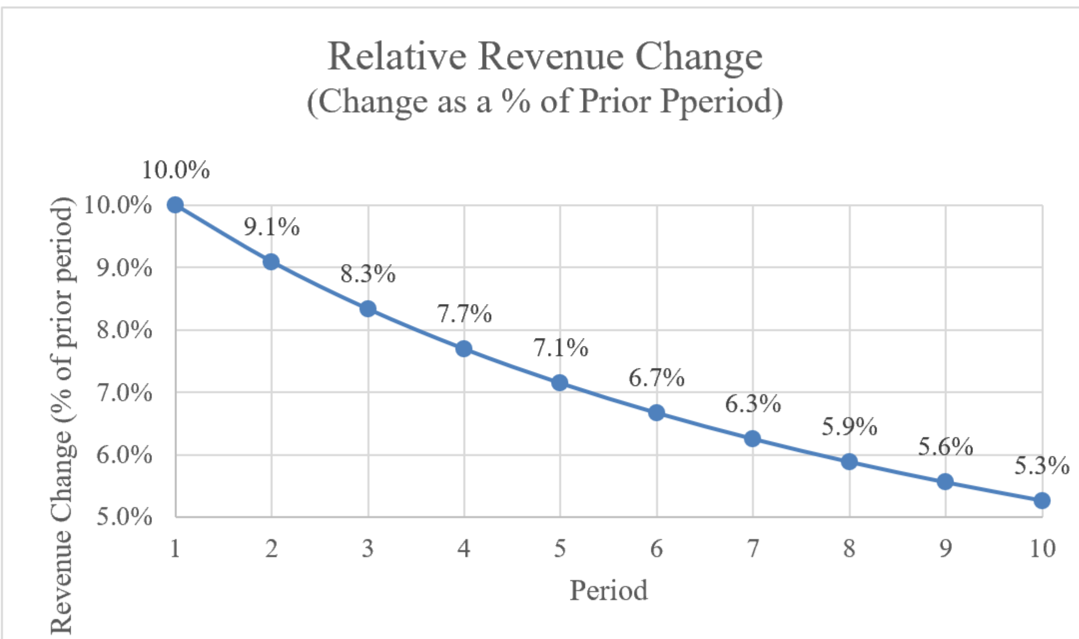

Figure 2.2. Relative Revenue Change in Revenue Over Time

It is clear from Table 2.1 and Figure 2.2 that the relative revenue growth is NOT constant in this example. Indeed, the revenue growth rate is decreasing over time.

When examining financial statements over time, everything is typically changing: revenue, costs, etc. We therefore need an "anchor" to fix the relative changes. In finance they call that "common sizing" an income statement (more on that in Chapter 3). For a financial income statement, everything in a "common sized" income statement is stated relative to the REVENUE for any given period.

Relative change and common-sizing combine to determine how changes are measured. If we are examining revenue growth, as we just did, then we want to exam relative revenue growth. In other words, growth as measured as a percentage increase/decrease of the revenue in the previous period, NOT in absolute dollar-terms. If we are examining costs, we will first measure those costs as a fraction (or percent) of the revenue of that period. The changes in costs will then be measured as changes in these "% of revenue" values. Everything is relative and it is all reported relative to revenue.

Measuring Change and Determining Final Values from a known Change
Two issues arise repeatedly in financial analyses. One is the issue we have been discussing, which is how to determine a relative change based on historic values (Equation 2.2). the second is, if the change is known, determining an element's future value. In corporate finance, determining a future value for an element (be it revenue, or a cost measure), is a three-step process. Step 1- the firm's historic values are assessed to determine the relative changes in each of these elements (revenue growth, costs, etc.). Step 2- future revenue growth rates (forecasts) for each of these elements are then made based on their historic values. Step 3 - The future $-value of the element is determined from the forecast of the change value. (In project financial analysis, however, there is often no historic values, which often reduces this three-step process down to only the third step.)

Step 2 of that three-step process, utilizes Equation 2.2, which is repeated below.

$$\textbf{Relative Change} = \frac{\textit{Ending Value} - \textit{Initial Value}}{\textit{Initial Value}} = \frac{\textit{Ending Value}}{\textit{Initial Value}} - \mathbf{1} \qquad \text{Eq (2.2)}$$

Step 3 of that three-step process, utilizes Equation (2.3), below, which is derived by re-arranging Equation 2.2.

Ending Period Value = (Initial Period Value) * [1 + (Relative Change)] Eq (2.3)

Eq(2.2) and Eq(2.3) will be used so frequently in financial analysis that you'll learn to apply them without thinking.

Static versus Dynamic Excel Spreadsheets

Corporate finance is focused on the future. What implications do the decisions we are making today have on the organization's finances tomorrow? Finance is a crystal ball that allows us to peer into the future. It is not perfect, of course, but it is better than nothing. In our regular lives when faced with a decision we can make only a single choice and then we wait to see what happens. In finance, analysts are "soothsayers" that peer into many different potential futures and ultimately recommend choosing the best one. That means that financial analysts are NOT simply performing a single financial calculation—it is not the singular "correct" answer we aim to calculate. That would be a mathematics problem solution. In finance, our aim is to create DYNAMIC MODEL that we can use to test many different future scenarios (see how a variety of inputs change the outcome). In short, we will want to do a great many "what if" iterations using the financial spreadsheet we are constructing.

In order to perform many different "what if" scenarios, we need a DYNAMIC spreadsheet. That is, we need one that we can easily change inputs values and see how those changes impact the output. A static spreadsheet will do the calculation, but will be quite opaque as to what we did. Sure, we can search through the spreadsheet by examining it cell-by-cell, but that will be VERY tedious if the analysis we are doing is very complicated at all.

Let's look at a very simple example. This example will be covered more thoroughly in the video "V2.1_Static vs. Dynamic Spreadsheets." In this example, we want to know the impact of various growth rates on the firm's revenue 10 years into the future. We are assuming that we currently have $1000 in revenue and will grow it by some constant annual grow rate.

The following spreadsheet is very static and assumes that the growth rate is 10% per year. That may be what your boss asked you to assume initially. As soon as you have that answer, you can bet that boss will ask "what if the growth rate is 9%?.... 12%?"

Year	0	1	2	3	4	5	6	7	8	9	10
Revenue (const. % change)	1000	1100	1210	1331	1464	1611	1772	1949	2144	2358	2594

Figure 2.3. Static Spreadsheet

This static spreadsheet, Figure 2.3, is quite opaque in that one cannot tell by looking at it that the annual revenue growth rate used in the calculation was 10%. On top of that, if we want to check to see what the revenue in year 10 could be for a different constant growth rate, we would need to change nearly every cell in this spreadsheet. Not good.

Since we know we will be doing "what if" analysis, we need to build a dynamic spreadsheet from the start. Even if we are not asked to do so, because finance is about insight not finding a single answer. The "Static versus Dynamic" video demonstrates the building of a couple of different versions of dynamic spreadsheets. The "best" version is one with a clear "input table." Now having an input table on a spreadsheet as simple as this example (see Figure 2.4) is definitely over-kill, but it is the thought process that counts. I personally have created financial models that were comprised of five separate Excel® workbooks with 5-7 inter-related worksheets in each workbook. I can tell you that without a clear and concise "input table" it would have been easy to overlook a variable change in one of those 25-30 highly-integrated spreadsheets!

Input Table	
Starting Revenue Value ($):	1000
Annual Revenue Growth Rate (%):	10.00%

Year	0	1	2	3	4	5	6	7	8	9	10
Revenue (Constant % change), ($):	1000	1100	1210	1331	1464	1611	1772	1949	2144	2358	2594

Color Coding:
XXXX Blue -- Hand-entered data
XXXX Black -- Calculated value or Value linked to another cell

Figure 2.4. Dynamic Spreadsheet

Present Value of Future Cash

When financially evaluating and comparing projects we need a common basis for which to make that comparison. We also need to be able to compare doing something with doing nothing. One way to do that is to view each options in terms of what it is worth today. Every potential project will do something in the future: create new revenue, reduce future costs, etc. If we can determine today's value of that future activity, then we will have a common basis with which we can compare all projects. This is known as determining the present value of a future cash flow. Doing nothing will generate no future cash, making the present value of doing nothing zero.

<u>Components of future cash value changes</u>

We know the potential of having a $1 tomorrow is not the same value to us as a $1 in our hand today. First there's the time value of money. Inflation causes prices to go up which lowers the value of a future dollar. As of this writing, the 10-year US treasury bond yield was 2.83%. That 10-year US treasury bond rate is often used as the "risk-free" rate or the "time value of money" rate.

Risk is another large influencer on today's value of future cash. Say you loaned me $5 today and I promised to repay it in a year, would you be OK with me paying you back $5? Maybe, if we are good friends, but otherwise not likely. The reason is two-fold. One is the time value of money we just discussed and the other is risk. What if I get hit by a bus and cannot repay you in a year's time? You want the money you receive a year from now to reflect that risk. Let's say, for example, that you loaned $5 each to 10 different people with the expectation of repayment in a year. Ignoring the time value of money for now, that means you expect to receive $50 in total from all of the loanees a year from now. However, from your history of providing such loans in the past, you know that the odds are that only 8 of the ten will actually repay you while the other two will default. That means that the $50 you expect a year from now—the amount required to make you whole--will have to be provided by only 8 of the borrowers. Each of those eight borrowers would have to pay you back $6.25 ($50/8) on the $5.00 they were loaned in order for you to break even. From Equation (2.2) in the previous section that means each of borrowers would pay 0.25 or 25% on the loan: ($6.25-$5)/$5. The "risk rate" for this loan would be 25%. If we now add the annual "risk-free" or inflation rate (2.83%) to this "risk-rate" you may want to charge each borrower 28.83% interest on their loan.

The third component that alters the value of money over time is the source from which the money was obtained in the first place. Let's say you wanted to put $100 into an investment that you believed would yield great returns (crypto currency, your friend's startup company, whatever). The problem is that you don't have the $100 to invest, but your uncle is willing to loan you the money. Your uncle will charge you 10% per year interest on that loan. The money you earn on your $100 investment has to be above the 10% your uncle is charging you in order for you to make any money. Let's say that the investment will take three years to mature. At the end of the three years, you will owe your uncle, $133.10 as shown in Figure 2.5 below. The value of the investment you are making with money borrowed from your uncle, must therefore be more than $133.10 for you to make any money on the investment. If your investment had a 10% return, you would break-even as the money you made on the investment would be exactly what you owned to your uncle for providing the loan in the first place.

Uncle's Loan Interest Rate (%/year): 10%

Year	0	1	2	3
USD owed to Uncle:	100.00	110.00	121.00	133.10

Figure 2.5 Loan Repayment

Generally, for an investment made in Year 0, the value of the investment compounded at the annual (and constant) growth rate would be (utilizing Equation 2.3) for any future period (N):

$$\text{Value (N)} = \text{Value (0)}*(1+R_g)^N \qquad \text{Eq (2.4)}$$

Where, "N" is the number of periods and R_g is the compounded growth rate per period.

Corporate WACC

The total expected changes in the value of money over time is the sum of all the previously discussed components: risk-free rate, risk-rate, and source of money. Companies do not borrow money from their rich uncle, but they do get it from loans (debt) and from their investors (equity). That means the "source of money" for companies comes at a cost. A company's WACC or Weighted-Average Cost of Capital incorporates all three components of the cost of money (more about this in Chapter 4). The WACC therefore represents the rate of return that the company must earn to break even while providing their investors (and loan originators) with the return rates they expect.

Calculating the Present Value of Future Cash Flows

Let's say that our company's WACC is 15%. That means that the company needs to generate a return of 15% per year to satisfy its investors and loan originators (and account for the time value of money, and risk). In other words, it needs to increase its net profit by 15% per year in order to achieve a growth rate equivalent to its WACC. If the investment amount was $1000, then by the end of the first year the amount the firm would need to earn after 1 year was $1150 (or $1000*(1+0.15)). By the end of the second year that number increases another 15% to $1322.50 (or $1150*(1+0.15) = $1000*$(1+0.15)^2$). This compounding continues until by the end of year 10 the project would need to generate $4045.56 as shown in Figure 2.6 below. That value results in multiplying the original $1000 by (1+0.15) ten times which is equivalent to: $1000*$(1+0.15)^{10}$. In short, Figure 2.6 shows how much money we would need to accrue in future years to order to achieve a rate of return equivalent to the company's WACC on that $1000 investment.

Revenue Annual Growth Rate: 15%

Year	0	1	2	3	4	5	6	7	8	9	10
Investment Required Return ($):	1,000.00	1,150.00	1,322.50	1,520.88	1,749.01	2,011.36	2,313.06	2,660.02	3,059.02	3,517.88	4,045.56

Figure 2.6. Future Value of $1000 growing at WACC

Let's flip our thinking round. The \$1150 at the end of year one, represents the value required to attain 15% return on our initial \$1000. Now, thinking about it backwards, if we DISCOUNTED that future value of \$1150 in Year 1 by 15% (divided it by 1+0.15), it would have a PRESENT value of \$1000. Thinking about it in this way, when working it backwards, the 15% represents the DISCOUNT RATE at which we are discounting future cash flows to obtain their present value. The 1/(1+0.15) = 0.8696 would represent the discount factor for Year 1 that when multiplied by the Future Value would result in the Present Value. More generally:

$$PV_N = FV_N * DF_N \qquad \text{Eq (2.5)}$$

Where the PV_N, represents the present value for the future value of Year "N" and FV_N, represents the Future Value in Year "N" and DF_N represents the Discount Factor for Year "N".

The discount factor, as we saw for year 1 was $1/(1+D_r)$, where Dr is the discount Rate. For year 2, the Discount Factor is the Year 1 discount Factor again divided by (1+Dr) or

$$DF_2 = DF_1/(1+D_r) = \frac{1}{(1+D_r)^2}$$

The Discount Factor (DF) for year "N" can then be generalized to :

$$DF_N = \frac{1}{(1+D_r)^N} \qquad \text{Eq (2.6)}$$

Where D_r is the discount rate and "N" is the number of years into the future.

Utilizing Equation 2.6, we can calculate the discount factor for ANY future cash flow stream for using any discount rate.

Figure 2.7 begins with the same values as Figure 2.6, but now a discount rate has been added to the input table and a discount factor has been calculated for each year, using that discount rate. Finally the present value for each future year's value has been calculated by multiplying the future value times the discount factor for that year. (See Video V2.2_Discounting_Future_Values for details.) Note that since the growth rate that we used to produce the future values is identical to the discount rate (both 15% in this example) that the present value simply returns to the original Year 0 value. Again, the point here is to demonstrate that discounting is merely the inverse of the more familiar technique of compounding future growth. The difference is that a project's future growth rate can (and often does) vary over the time span of a project, while the discount rate will always be the same for every project year.

Revenue Annual Growth Rate:	15%
Discount Rate:	15%

Year	0	1	2	3	4	5	6	7	8	9	10
Future Value (\$):	1,000.00	1,150.00	1,322.50	1,520.88	1,749.01	2,011.36	2,313.06	2,660.02	3,059.02	3,517.88	4,045.56
Discount Factor:	1.0000	0.8696	0.7561	0.6575	0.5718	0.4972	0.4323	0.3759	0.3269	0.2843	0.2472
Present Value (\$):	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00

Figure 2.7. Present Value of Future Cash Flows

Discounting at a Project Hurdle Rate

When valuing companies, the appropriate discount rate to use is the company's WACC (Weighted Average Cost of Capital), as it represents all three factors that influence the present value of future cash (risk-free rate, risk, and capital source). Some companies also use the WACC as the discount rate when evaluating specific company projects. However other companies discount projects utilizing a "Hurdle Rate" which is typically 1-2% higher than their WACC. Those companies consider the risk that is baked into their WACC a company-wide risk, and therefore argue that any given project may have a slightly higher risk. Whether companies use their WACC or a Hurdle Rate, it is important that an organization use an identical discount rate for every project evaluation so as to put all the projects on a financial level playing field. Changing the discount rate from project-to-project in order to account for the variability of the project "risks" makes project comparisons impossible. It is far better to use an identical discount rate and determine specific project using other tools (like Tornado Diagrams) that will be discussed later in this book

Warning. Some will argue that, "I believe project X is riskier than project Y, so we should discount project X at a higher discount rate than the one used for project Y." That's an erroneous approach to assessing risk as it becomes a self-fulling prophesy. Increasing the discount rate (given this is a non-linear function, a little change in the discount rate can make a big difference in the discount factors) favors the present. Since an investment is typically made in up-front in any project in order to generate future revenue, any shift in the analysis that favors the present favors the "do nothing" strategy. As the discount rate goes to infinity, for example, all future discount factors go to zero, which then means only the investment (year 0) has any present value. That, in turn, means that the project will have a negative impact on the firm and should not be executed. Again, the self-fulfilling prophecy – believing the project was riskier led to increasing the discount rate which lead to a calculation that "proved" the project was risky and should not be move forward. It is much better to discount ALL projects within a company using a consistent discount factor and then tease out the risks in other ways (as will be discussed in the later part of this book). Organizations may, of course, want all of their projects to break even (pay for themselves) in a short amount of time, say 2 to 5 years. That requirement is perfectly valid and can be obtained by means, as will be discussed later, other than manipulating the discount rate from project-to-project. The bottom line is that manipulating the discount rate is risky business which will unlevel the project evaluation playing field and therefore should be avoided.

Chapter Summary

This chapter provided some essential background which will be foundational for the analyses presented later in this book. The first of the three topics presented was the mathematics of change. When organizations say "consistent growth" they mean growth rates measured in per cent, not $-figures.

Two challenges will be consistently faced in any project analysis. Either the relative change in a variable needs to be determined or the new future value of a variable needs to be predicted based on an estimate of its change rate. Equations 2.2 and 2.3 will therefore be utilized over and over during any financial analysis.

The second topic of this chapter discussed the difference between tables, static spreadsheets and dynamic spreadsheets. Tables are nothing more than numbers typed into Excel® cells. It may be useful to create tables of results, but the goal in financial analysis is to create financial models that utilize the power of Excel® to do the mathematics for us. On the other hand, static spreadsheets contain cells with imbedded calculations, but the numbers in those cells are fixed. Static spreadsheets are of very limited use. Sure, they allow us to calculate a single answer, but that is all. Any change in the input data requires finding, and then changing the necessary cells in the spreadsheet, one-at-a-time.

Given the goal to create financial models that can answer "what-if" questions, the aim is to create dynamic spreadsheets. The ideal dynamic spreadsheet has the changeable input values separated from the calculation section of the spreadsheet. Doing so aids in locating and changing these input variables. Color-coding is also helpful, making all input values a constant color (say blue) makes them stand out from cells that are doing calculations. In addition to input tables, complicated models may also have output tables, or results area located near the input table so that changes in the output can be easily seen as the input variables are changed.

The final section of this chapter illustrated how to determine the present value of future cash flows. All valuations, ranging from the valuation of a project to the valuation of an entire company, is performed by determining the present value of the future cash flows. Those future cash flows must be discounted back to the present. The appropriate discount rate was discussed and determined for projects to be either the company's WACC (Weighted-Average Cost of Capital) or a project hurdle rate that was the WACC plus some small differential (typically 1-2%). It was highly recommended that each project within an organization be evaluated at the same discount rate in order to keep the projects on a level playing field. Project risks, which will indeed vary from project to project, need to be teased out by other means and not by changing the discount rate.

The discount rate is central to calculating a discount factor for future cash flows. This discount factor represents the present value of a dollar in that future period. Equation 2.6 shows the equation for calculating the discount factor for any future period, for any discount rate.

The next chapter will provide a brief review of financial statements: Income Statement, Balance Sheet, and Statement of Cash Flows. Chapter 4 chapter will then discuss the "Q" and "M" elements of the $QMCR^3$ mnemonic used to approach project financial evaluations. Those two letters represent the "Question" that is being asked and the appropriate "Measure" to answer that question (or those questions). Chapter 4 will utilize the foundational elements discussed in this chapter to build dynamic financial assessment models for projects.

CHAPTER 3: FINANCIAL STATEMENTS

There are three fundamental financial statements that all public companies are obligated to report. The three are the Income Statement (I/S), the Balance Sheet (B/S) and the Statement of Cash Flows (C/F). Together, the three create a thorough financial picture of the organization.

Income Statement

The Income Statement presents the firms revenue and costs over a specific period of time. It also demonstrates whether or not the organization has earned any money over the period assessed, which is why the Income Statement is also referred to as the "Earnings Statement" or the "Profit and Loss" (P&L) statement. The income statement is transaction-oriented in that it describes the revenue for the goods/services provided to customers and the resources consumed in producing and delivering those goods/services. While the primary focus of the I/S is on the on-going operations of the firm, the statement also records income and expenses from non-operational activities, i.e., those activities not directly related to the firm's core business.

Figure 3.1, below, illustrates the primary sections of the income statement. The I/S begins with the revenue attained over the period assessed. The costs directly attributable to the creation of the product and/or service are then subtracted, leaving the Gross Profit. Other operating expenses, or expenses indirectly related to the production, distribution and sales of the firm's product/service are subtracted from the Gross Profit leaving the Operating Income. "Other" revenues/ costs are then added/subtracted. These are other sources of income or expenses not related to the firm's core business. Finally, the I/S shows the amount of taxes paid and the resulting Net Income. It is this net income that is re-invested in the firm and/or distributed to its owners.

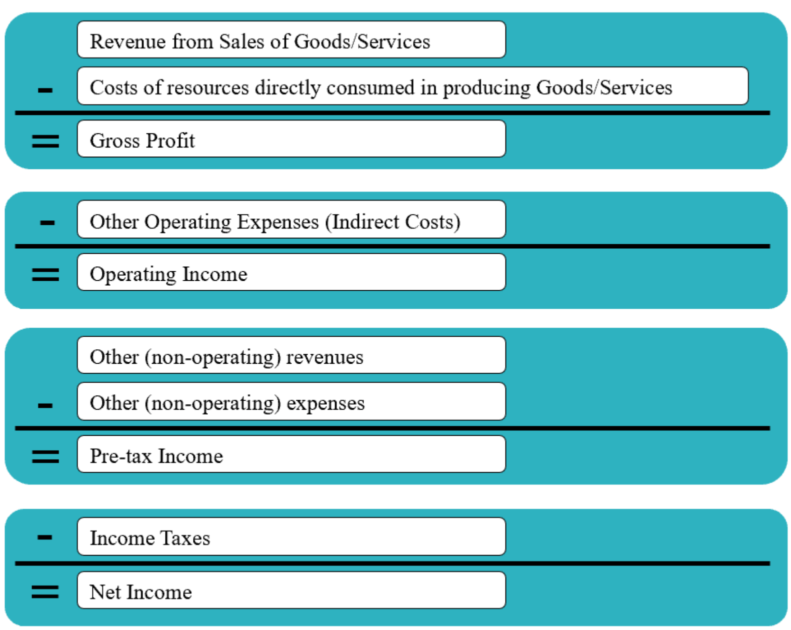

Figure 3.1. Elements of an Income Statement

Direct Costs

The direct costs are those directly attributable to the creation of the product/service. There are typically two components of this direct cost: Cost of Goods Sold (COGS) and the Depreciation of equipment required to create the product/service. Public firms often combine these two components and expressed them as a single "Cost of Revenue" value.

COGS: Cost of Goods Sold

The Cost of Goods Sold includes those costs directly attributable to the creation of the product or the delivery of the service. There are two components of COGS: Labor and materials. The labor costs here are not the entire labor force of the organization, but only those directly attributable to the product's creation or the service's delivery. The same holds true for raw material costs, it is only the materials needed to create the product or consumed in the delivery of the service.

Depreciation and Amortization

Depreciation and amortization (D/A) are "non-cash" costs. Depreciation is a way to spread out the cost of a capital item (typically PP&E: Plant, Property and Equipment) that is necessary to create the product or deliver the service over the item's useful life. Amortization does the same for intellectual property. No one "pays" depreciation/amortization costs, which is why they are "non-cash" costs as there is no "transaction" related to these expenditures. The car you own will likely be worth less next year than it is now. You certainly don't pay anyone the amount of that value drop. Depreciation is therefore not a "real" transaction-oriented cost. Then why do businesses keep track of it?

Let's say that car is owned by the business and is critical to your delivery service. At some point in time that car will wear out; that's what accountants call reaching the "end of its useful life." At that time, the business will need to purchase another car. If the car's depreciation cost is not somehow incorporated into the service's (or product's) price, then the business may have undercharged for their service and, as a result, not have made enough money to purchase a new car when that time comes. D/A spreads out one-time or "lumpy" investments that are directly related to the production of the product or delivery of a service over time or per unit of product or service ensuring that the company appropriately accounts for the full cost of its offering.

As we will see, however, if Depreciation/Amortization (D/A) is accounted for in the income statement, it will need to be added back in the Statement of Cash Flows (C/F) as that statement measures the flow of cash in and out of the organization. Given that D/A is a "non-cash," non-transactional cost, it should not be accounted for in the C/F statement as it is not associated with any cash flowing in or out of the business. The actual "lumpy" capital investments are recorded in the period they are incurred in the statement of cash flows and not "spread out" as they are in the Income Statement. Given that the "net income" from the Income Statement is transferred to the Statement of Cash Flows from the Income Statement, if D/A is indeed included in the calculation of that "net income" as a cost, then it has to be added back in the C/F statement to offset that entry in the I/S.

Teasing out COGS from "Cost of Revenue"

As previously mentioned, the COGS and D/A values are often combined and reported by public companies as a single "cost of revenue" value. Unfortunately, when looking at the I/S for a public firm, it is not at all clear, by looking solely at the I/S along, whether or not D/A is or is not included in that "cost of revenue" line-item. To resolve that issue, one needs to look at the Statement of Cash Flows. If there is a line item adding D/A to the statement of cash flows, then D/A must have been included as a direct cost in the Income Statement. There is no need to adjust the C/F statement by adding the non-cash cost of D/A unless it had been incorporated as a cost in the Income Statement. As a result, for cases where a line-item for D/A is indeed incorporated in the Statement of Cash Flows, then it is clear that the line-item for "Cost of Revenue" in the income statement did include D/A. Therefore, ONLY for cases where there is a line-item for D/A in the C/F statement:

Cost of Revenue = COGS + D/A

COGS = Cost of Revenue – D/A

Where this D/A value is listed in the Statement of Cash Flows. Again, this is ONLY for cases where there is a line item for Depreciation/Amortization in the C/F statement.

It is always clearer, and therefore recommended, to create an income statement that contains seperate line items for COGS and D/A, versus one that contains the vague "Cost of Revenue" entry. For the case where there is a D/A line-item in the C/F statement (and only in those cases, the "Cost of Revenue" line item in the income statement can be re-written as two entries:

COGS = (Cost of Revenue – D/A)

D/A

Where D/A represents the line item for Depreciation/Amortization found in the Statement of Cash Flows. For cases where there is NO D/A line-item in the Statement of Cash Flows, then the "Cost of Revenue" is equal to the Cost of Goods Sold (COGS).

Indirect Costs

Beyond the direct costs, every product/service has indirect costs associated with its creation and delivery to the customer. Those range from sales and marketing costs to general management costs. It may also include efforts to continuously improve the product if that effort is necessary to keep the firm's product competitive. The "indirect" costs, sometimes referred to as the organization's "overhead" costs typically fall into three categories: Sales, General and Administration (SG&A) and Research and Development (R&D) and "other." The R&D only applies here if it is on-going and aimed at continuously improving the firm's existing products. An R&D program targeting the development of new products for the firm would not be included here. The "other" category of indirect costs can include a wide variety of items, such as the maintenance costs for the facility used to create the product.

Figure 3.2 shows the five-year income statement for the accounting and consulting firm Accenture (stock ticker: ACN). (The data below was obtained in April 2022.) Note that the "Cost of Revenue" entry that was originally reported as a line-item in the income statement, has been sub-divided into COGS and D/A line-items by utilizing the line-item for Depreciation/Amortization listed in the firm's reported Statement of Cash Flows. (Note that Figures 3.2, 3.3 and 3.5 are located in the Excel® workbook entitled "ACN_Free_Cash_Flow_Model_Data_0422.xls" which is the third workbook of the Excel® companion pieces to this text. This workbook contains the Income Statement, Balance Sheet and Cash Flow Statements for Accenture that has been downloaded in April of 2022 (ACN, 2022). This downloaded data is then mapped into a Free Cash flow template—ACN FCF Model—that is the first tab of this workbook. This reusable template can be utilized with any downloaded company input data.)

Income Statement					
	All values in	Millions of US Dollars			
	31-Aug	31-Aug	31-Aug	31-Aug	31-Aug
Year:	**2017**	**2018**	**2019**	**2020**	**2021**
Total Revenue	36,765	41,603	43,215	44,327	50,533
COGS (with NO D/A)	24,933	28,234	29,007	28,578	32,278
Depreciation and Amortizatoin	802	927	893	1,773	1,891
Gross Profits (including D/A)	11,030	12,442	13,315	13,976	16,364
SG&A	6,398	6,602	7,010	7,463	8,743
R&D (on-going)	0	0	0	0	0
Operating Income	4,632	5,840	6,305	6,513	7,621
EBITDA	5,434	6,767	7,198	8,286	9,512
Interest Income (Expense)	-16	-20	-23	-33	-59
Other Income (Expense)	-1	-13	-30	294	199
Earnings Before Taxes (EBT)	4,615	5,807	6,252	6,774	7,761
Income Tax Expenses	981	1,593	1,406	1,589	1,771
NET INCOME from Operations	3,634	4,214	4,846	5,185	5,990

Figure 3.2. Accenture's (ACN) Income Statement

<u>EBITDA</u>

EBITDA is an acronym for **E**arnings **B**efore **I**nterest, **T**axes, **D**epreciation and **A**mortization. That is a mouthful to say, which is why the term is generally referred to only as EBITDA (pronounced eebit-dah). EBITDA is the revenue less COGS, less SG&A, less R&D (if on-going) and less "other" indirect costs. It differs from "operating income" in that EBITDA does NOT include depreciation/amortization (D/A).

EBITDA = Gross Profit – Indirect Costs + D/A

Where D/A represents the value of depreciation/amortization included in the direct costs of the income statement.

Whereas,

Operating Income = Gross Profit – Indirect Costs

In project valuation, or company valuation, we are interested in the present value of the future free cash flow generated by the project (or the entire company, for corporate valuations). We are therefore not interested in depreciation/amortization costs as they are "non-cash costs." As a result, financial valuators of either projects and/or organizations prefer and utilize EBITDA over "operating income" as EBITDA represents the pre-tax cash flow produced by the firm's operations as EBITDA (because it does not include those non-cash depreciation/amortization costs).

<u>Common Sizing</u>

Finance is focused on future growth and change, not recording historical values. Finance's focus is on identifying and predicting growth and looking for and predicting trends as a way to explain the past and predict the future. When looking at the revenue and COGS line-items of Figure 3.2, it is very difficult to say if the firm's growth is steady or to see how the COGS value may be changing relative to the Revenue. To resolve that issue, the line-items in all of the three major statements (I/S, B/S, and C/F) are typically common-sized. Common sizing presents the data for each time period in each statement as a percent of a specific value of that period. For Income Statements and Statements of Cash Flows, each line for a given period is “common sized” by dividing every value of a given time period by the revenue value for that period. These ratios are typically presented as “margins” or as a “% of revenue.” COGS, SG&A and other expenses are, when appropriately common-sized, reported as “COGS Margins,” SG&A Margins,” etc. The “margin” indicating that the value is stated as a percent of that period’s revenue value.

Reporting a “common-sized” revenue value would not be insightful as that value is always 1 or 100% of itself. Because of that, but more importantly, the fact that a measure of how revenue is changing is what’s of critical interest to the firm, means that revenue is tracked in terms of year-to-year growth. However, as was discussed in Chapter 2, it is not the $-figure change in revenue we are interested in tracking, but change relative to the prior year. We seek to understand the current-year revenue’s change relative to the prior year’s value, described by Equations 2.2 and 2.3 of Chapter 2 which re repeated here as Equations 3.1 and 3.2, respectively:

$$\textbf{Relative Change} = \frac{\textbf{\textit{Ending Value}} - \textbf{\textit{Initial Value}}}{\textbf{\textit{Initial Value}}} = \frac{\textbf{\textit{Ending Value}}}{\textbf{\textit{Initial Value}}} - \mathbf{1} \qquad \text{Eq (3.1)}$$

Rearranging Equation 3.1 yields:

$$\textbf{Ending Period Value = (Initial Period Value) * [1 + (Relative Change)]} \qquad \text{Eq (3.2)}$$

Figure 3.3, below, common-sizes the major line-items of Figure 3.2. There cannot, of course, be an AGR (Annual Growth Rate; sometimes referred to as the annual compounted growth reate, ACGR) for the revenue in year 2017 as we do not know the revenue in the prior year (2016).

YEAR	2017	2018	2019	2020	2021
Common-sized Income Statement:					
AGR Revenue(%/yr):		13.2%	3.9%	2.6%	14.0%
Gross Margin Inc. D/A (%):	30.0%	29.9%	30.8%	31.5%	32.4%
COGS Margin NO D/A (%):	67.8%	67.9%	67.1%	64.5%	63.9%
SG&A Margin (%)	17.4%	15.9%	16.2%	16.8%	17.3%
		-8.8%	2.2%	3.8%	2.8%
R&D & Other Margin (%)	0.0%	0.0%	0.0%	0.0%	0.0%
EBITDA Margin ($)	14.8%	16.3%	16.7%	18.7%	18.8%
Net Income as % of Sales:	9.9%	10.1%	11.2%	11.7%	11.9%

Figure 3.3. Tracking Accenture’s Income Statement item “Margins” (% of Revenue)

The Gross Margin (or Gross Profit Margin) for 2017 is the $11,030 value shown in Figure 3.2 divided by the revenue for that year ($36,765), or 30% of revenue. For 2021, that same value is gross profit for 2021 ($16,364) divided by the revenue value for that year ($50,533), making Gross Profit Margin for 2021 32.4% of revenue. Similar calculations are performed for the other variables, always dividing their value by the revenue for that year.

Unlike in Figure 3.2, in Figure 3.2 we can clearly see how Accenture’s annual revenue growth has been inconsistent: 13.2% in 2018, then down to single low single-digits in 2019 and 2020, then rebounding to

14% in 2021. Why? Likely the result of the pandemic, but if you were assessing this firm, it warrants further investigation.

Figure 3.3 also reveals that the COGS Margin was fairly steady through 2019, then declined significantly in 2020 while the SG&A Margins slowly rose from 2018 through 2021. Both of these line-item changes over time beg the question, why? Was there a policy change? Layoffs due to the pandemic? Impact of "the great resignation?" Further investigation is again warranted if trying to assess the firm, but the point here is that these trends, which would be difficult to impossible to spot by looking at the raw data of Figure 3.2 have been clearly illuminated by common sizing the values of the income statement. A manager's job is, after all, to "find and fix" organizational problems. Common-sizing makes it easier to identity issues, the "find" half of that task.

Balance Sheet

An organization's balance sheet captures what it owns and owes at a specific moment in time. While the income statement captured the revenues and costs of activities that occurred over a period of time, the Balance Sheet is a snapshot at a specific moment in time. Balance sheet items are classified as "assets" of the organization or "liabilities." Assets are what the firm owns or is owed, whereas liabilities are what the firm owes. If you purchased a $5000 car by borrowing $2000, the $5000 would be recorded on your personal balance sheet as an asset and $2000 loan recorded as a liability.

It is called a "balance" sheet as the firm's Assets must equal its Liabilities plus the Owner's Equity. In the car example, the $5000 asset = $2,000 liability + Owner's equity; meaning you have $3,000 equity in the car at this moment in time. The "owner's equity" that appears on the balance sheet for a company is NOT the value of the on-going firm. Owner's Equity is the "book value" or "liquidation" value of the organization. If the firm was being sold off for pieces and parts, the "owner's equity" is what would be left after selling all the firm's assets and paying off all of its liabilities. In the example, if you turned around and sold the car you just purchased for $5000, you would use $2000 of that to pay off the debt (liability) and the remainder is what is left over (Owner's Equity). Owner's Equity can be positive or negative. The value of an on-going concern is, by contrast, the present value of the free cash flow that firm is predicted to generate into the future. Those are very different numbers. The value of an on-going firm is called the firm's Market Capitalization or "Market Cap," which for a publicly-traded firm is the firm's share price times the number of shares it has outstanding.

On the balance sheet, assets and liabilities are classified as either "current" or "non-current" (sometimes referred to as "long-term"). "Current assets" are items that can be turned into cash quickly and easily, the rule-of-thumb being 30 days or less. They include cash, inventories, and accounts receivables, and short-term investments. PP&E (Plant, Property and Equipment), which represents the assets required to produce the product and/or deliver the service, are considered long-term assets as they are not able to be readily turned into cash. Current liabilities are debts that must be paid in the next 30 days. These include accounts payables, short-term debt, current portion of long-term debt. Your car payment would be an example of the current portion of your car loan (the car loan representing the long-term debt). The general categories of items typically found on a Balance Sheet are shown on Figure 3.4, below.

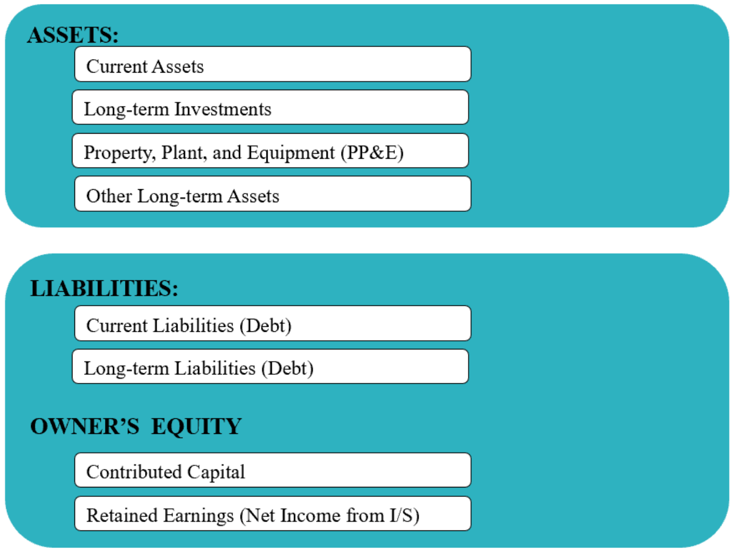

Figure 3.4. Items of a Balance Sheet

Figure 3.5, below, shows the Balance Sheet for Accenture (ACN; obtained in April 2022). Note how for each year the "owner's equity" plus the firm's liabilities must equal the firm's assets. As a result, "owner's equity" for any given year is a calculated figure; determined by the firm's total assets less its total liabilities.

Balance Sheet						
	All values in	Millions of US Dollars				
	31-Aug	31-Aug	31-Aug	31-Aug	31-Aug	
Year:	**2017**	**2018**	**2019**	**2020**	**2021**	
Assets						
Cash and Short-term Investments	4,130	5,065	6,130	8,510	8,172	
Total Recievables	4,569	4,996	8,095	7,847	9,728	
Other Current Assets	3,398	3,525	1,225	1,393	1,766	
Total Current Assets	12,097	13,586	15,450	17,750	19,666	
Gross PP&E	3,053	3,126	3,347	7,043	7,234	
Accumulated depreciation	-1,912	-1,862	-1,956	-2,314	-2,412	
Net PP&E	1,141	1,264	1,391	4,729	4,822	
Equity and Other Investments	212	216	240	325	330	
Goodwill	5,002	5,383	6,206	7,710	11,126	
Intangible Assets	710	687	841	1,029	1,711	
Deferred Income Taxes	2,215	2,087	4,349	4,153	4,007	
Other Long-term Assets	1,313	1,227	1,312	1,383	1,514	
Sub-total Other Assets	9,452	9,600	12,948	14,600	18,688	
TOTAL ASSETS	22,690	24,450	29,789	37,079	43,176	
Liabilities						
Accounts Payable	1,525	1,349	1,647	1,350	2,274	
Short-term Debt	3	5	6	8	12	
Taxes Payable	1,092	498	378	1,116	1,033	
Accrued Liabilities	4,535	5,462	5,842	5,796	7,416	
Deferred Revenues	2,670	2,838	3,189	3,637	4,229	
Other Short-term Liabilities	0	0	0	756	744	
Total Current Liabilities	9,825	10,152	11,062	12,663	15,708	
Long-term Debt	22	20	16	54	53	
Deferred taxes liabilities	137	126	133	180	244	
Deferred revenues	663	618	565	691	700	
Pensions and other benefits	1,409	1,411	1,766	1,859	2,016	
Minority interest	761	360	419	499	568	
Other Liabilities, non-current	924	1,399	1,420	4,133	4,357	
Sub-total	3,916	3,934	4,319	7,416	7,938	
TOTAL LIABILITIES	13,741	14,086	15,381	20,079	23,646	
Equity						
Total Equity	8,949	10,365	14,409	17,001	19,529	
Total Liability & Equity	22,690	24,451	29,790	37,080	43,175	

Figure 3.5. Accenture's (ACN) Balance Sheet

<u>Working Capital</u>

Working capital is the firm's current assets less its current liabilities. It represents the amount of money the firm has tied up in their on-going operations. It can also be thought of as the amount of cash the firm needs to keep on-hand to cover the timing difference between when it needs to pay its expenses and when it actually receives revenue. Working capital naturally fluctuates with revenue, but must be managed. A company that sells t-shirts with printed designs needs to have blank t-shirts and ink on hand. It also likely has some t-shirts "in process" at any moment in time, in addition to an inventory of finished goods. These items usually have to be paid for before any product sales occur. While the income statement may show a nice gross profit, the timing of receiving the revenue and paying for the costs may be off. The result is that the company must have enough cash on hand to pay for its current assets (less its current liabilities), before the revenue is actually received. As a firm's operations grows, the firm's working capital will also increase. Growing firms have gone into bankruptcy by not properly managing their working capital and, as a result, not having enough cash on hand to pays their bills when they become due. Too much working capital, on the other hand, limits the firm's ability to invest in other, long-term, opportunities and projects. A balance between these two extremes must therefore be struck.

Statement of Cash Flow

The third and final financial statement, C/F, is the statement that tracks the flow of cash in and out of the organization. While this is typically the least used of the three financial instruments in accounting, it is the most used in project finance. The cash flow statement, like the income statement, covers cash flow over a period of time. The cash flow for an organization combines the values from the income statement with changes in the balance sheet items.

Cash Flow =

Net Income (from I/S)
+ Depreciation/Amortization (if included on the I/S)
- Increases in Balance Sheet items

The "increases" in balance sheet items represents the changes in a balance sheet item from period to period. Since B/S items are from a single snapshot in time, it is the change in the balance sheet item that represents a change in the company's cash. For company-wide cash-flow analysis, if depreciation was included as a "cost" in the income statement, it must be added back in the Statement of Cash Flows as it is not a "cash cost" and does not represent movement of cash in or out of the organization.

In performing project financial analyses, it is common to create a project's statement of cash flows directly, without first creating an income statement or balance sheet, as we shall see in Chapter 6. When financially evaluating projects, we are also only typically interested in the pre-tax cash flow generated by the project's operations. As a result, EBITDA values (and not "Net Income" values) from the Income Statement are the typical starting values for a project's a statement of cash flow as we are neither interested in "other income/(expenses)" or taxes or depreciation/amortization. Using EBITDA is convenient and avoids the messy business or concerns regarding the calculation of depreciation; D/A simply does not need to be determined as it never enters into the project's cash flow calculation. Balance sheet items for project analyses are typically limited to changes in PP&E (Property Plant and Equipment) and the project's impact on Working Capital (current assets less current liabilities). The result is that for a typical project,

Project Cash Flow =

EBITDA
- Increases in PP&E
- Increases in Working Capital

Sources and Uses of Cash

In tracking cash movement in and out of the organization it is convenient to distinguish "sources" of cash for the organization from "uses" of cash by the organization. The firm's cash flow includes the period-to-period changes in the balance sheet items. Sources or uses of cash are inferred by changes in the balance sheet item. Comparing a snapshot of a car's gas gauge today versus a week ago tells us only the change in gas we have on hand. If the gas gauge indicated that the tank was half-full a week ago and is now on "full" then we know that we now have more gasoline than what we had a week ago. This "**increase" in this balance sheet item** had to have been accompanied by a **use of cash**. We had to have put gas in the tank which costs money. (Note that we have no idea whether the car was driven during the period, we only know the change in the "Gas" balance sheet item.) In the reverse case, the tank started full and is only half-full now implies that the drop was equivalent to a SOURCE of cash for the firm (we could have sold that gas for cash, for example, or used the gasoline we had on hand to drive the car versus purchasing more). **Decreases in balance sheet items** over time therefore represent a **source of cash** for the organization. Thinking through sources and uses of cash with changing balance sheet items may initially take some time.

Cash Flow Activities

The cash flowing in and out of the organization are categorized according to the type of activity that produced the cash flow. Cash flows are organized into one of three general activity-categories. Cash flows that result from:

Operating Activities
Investment Activities
Financing Activities

Operating activities include the acquisition or production of goods and services, the sale and distribution of goods and services to customers, and changes in working capital (changes in current assets and liabilities). Investment activities include the acquisition or disposal of long-term assets. Financing activities are comprised mainly of transactions between a company and its owners or between a company and its long-term creditors. These financing activities include new stock issuance, dividends, and long-term debt.

The essence of virtually every project is to spend money up-front in order to increase revenues and/or decrease costs over time. As a result, project financial analyses are aimed at determining the value of the future cash flow driven by the project's operating activities and investment activities. The financing activities are typically ignored in project-level financial analyses as these are usually organizational-level and not project-level activities and the goal of project analyses is to put every project on an evaluative level playing field.

CHAPTER 4: PROJECT FINCIANCIAL MEASURES

Chapter 1 introduced the mnemonic for a standard approach to undertake project financial analyses. This is not the only potential approach, of course, but given the goal of evaluating all projects on a "level playing field," having a consistent approach is important. This chapter will build on the introduction in Chapter 1 by detailing the Q and M elements of that $QMCR^3$ analysis mnemonic.

Q: Question
M: Measure
C: Calculation
R^3: Recommendation, Risks, and Relevant context

In addition to the "Q" and "M" elements, this chapter will begin discussing the "C" element of that mnemonic; how to "calculate" the values we hope to measure in order to answer the questions. This chapter will only provide an introduction to the calculations with the real heavy-lifting regarding those calculations being detailed in Chapter 5. The text provided is meant to describe the concepts, while the associated videos will detail the step-by-step "how to" perform the calculations in Excel®.

Companies have more ideas for things to do than they can possibly execute. There are not enough resources to do everything a firm may want to do… not enough time, people or money to invest in every possible project idea. Beyond the resource constraints, many project ideas are simply not financially viable for a firm to even consider executing them. The benefits to the firm simply do not warrant the investment required. In other words, many potential projects will simply not increase the company's future cash flow. Afterall, the value of a firm is the present value of its future cash flow. Period. If a project does not add to the firm's future cash flow, it is certainly not worth doing from a financial perspective. Of course, there are projects that the company *must* do to stay in business. This 'must do' list includes making sure the company is in compliance with government regulations—such as meeting the air quality standards. Many times, however, project champions pitch their project to the firm's administration as a "must do," when it is not. Such project promotion is nothing more than a weak cover for a project that cannot be financially justified. Most firms, create financial impact reports for every potential project, regardless of whether they are a "must do" or not. In the early stages the projects may undergo little more than a cursory financial screen, while later, before they are executed, undergo a more rigorous financial analysis. This analysis allows the firms to prioritize the execution of financially viable projects. In the remainder of this book, we will focus on projects that need to be financially justified, be it via an initial financial screen or by virtue of a detailed financial assessment.

Question(s)

The questions that need answers regarding a project begin as fairly straight-forward ones. Shall we do it? Does it make financial sense to the firm to execute this project? What would be the financial impact on the firm if this project is successfully executed? If this is an initial screening of a project, what project elements would we want to understand in more detail before deciding the project's fate. How do we prioritize a financially-viable project against other potential projects across the firm? In other words, how does this financial impact compare with other projects?

If a wide variety of projects are to be compared and prioritized, then we need to create a "level playing field" upon which to make those comparisons. That means we need some type of standardized financial-analysis approach that can be applied to all projects.

The initial financial screen of any project should start with our assumptions of how we believe the project will proceed. That's the "base-case" scenario. We may strongly believe that the base-case scenario will occur exactly as we predict it, but we are, after all, predicting the future and we cannot know the future with absolute certainty. If the base-case scenario is not financially viable, then the project will be terminated at this point (or at least sent back to the originators for revision). If the base-case appears to be financially viable, we are not done, it simply means that the analysis moves forward to the next, more in-depth assessment level. That next level requires answering questions related to the uncertainty of the base-case scenario assumptions.

Uncertainties create risk. Every project has risks. We need to dig deeper than saying the project is "risky." Life is risky, yet we wake up and get out of bed and move ahead with our day anyway. What are the risks and what are the financial implications of those risks? Yes, the base-case valuation of the project may look promising, but some (and maybe all) of our initial assumptions regarding any project will be wrong. The deeper question that needs to be asked and answered for the next level of analysis is which of those base-case assumptions have a significant impact on the financial outcome of the project and which do not? Another way of asking the same question is, *under what are the conditions* does the project remain financially viable? These are the "boundary conditions" for the project's financial success. Understanding them not only helps inform a project's "go" / "no go" decision, but are tremendous aids in supporting the management guiding the implementation of the project. Which aspects of the project must be tightly controlled in order for the project to be successful and which are less important; i.e. have a lesser financial impact if these elements vary off their base-case assumed values?

A sound second-level financial analysis will also hone in on inputs that need more clarification before a "go" / "no go" decision can be made. Questions such as, "what should we know more about before deciding to go ahead with this project?" As every project is based on forecasts of what will take in the future, we need to understand how good our estimates are for those forecasts. How much time, effort and thought went into those forecasts? Did we just SWAG it or were the base-case assumptions grounded in a detailed study? When the engineering group, for example, was asked how much capital it would take to expand our production, did they just "guess"-- based on their experience of doing similar things in the past-- or did they perform a detailed study? (The engineer's "guess" for this type of estimate, for example, will be better than that of the average person, given their experience and expertise in the area, which is why such estimates are often called SWAGS -- *Sophisticate* Wild-Ass Guesses!)

More research may be required after an initial project financial screen, before deciding the future of a project proposal. We definitely do not want to put our head in the sand and say, "hey, the future is unknow, let's just do this project and see what happens." Oh, no. That simply will not do. That is not being fiduciarily responsible. Instead, we need to identify what elements of the project have the most impact on its financial outcome and then proceed to obtain better estimates for those elements BEFORE deciding on the future of the project. If variations in the capital estimate has a huge impact on whether or not the project will be financially viable, for example, then we need to go back to the engineering group and make sure that their estimate is as good as they can possibly make it… no SWAGS. Then if the project is chosen to go forward, the construction costs will need to be closely monitored. If it turns out that the capital estimate for the project has little impact on the financial impact on the project, then their initial SWAG may be good enough for now. A sound financial analysis should help focus and direct the resources of the firm.

Measure(s)

Some project proponents like to argue the income side of their project… 'this project could make us millions' (in revenue)! Other's may degrade projects by highlighting the cost side—' this project is too expensive to do.' The complete view of a project, however, is from a value-creation perspective. What future net cash flow does the project generate? A complete project financial analysis will assess the complete financial picture of the project –potential revenue and costs – including both investment and operating costs.

In accounting the statement of cash flows (C/F statement) was constructed from the organization's income statement (I/S) and balance sheet (B/S), as was covered in Chapter 3. For projects, that cash flow was determined to be in Chapter 3:

Project Cash Flow =

EBITDA (from I/S)

- Increases in PP&E
- Increases in Working Capital

However, unlike what is typically done in an accounting course, in project financial analysis one usually directly creates a project cash flow without first creating an I/S or B/S. Recall from Chapter 3 that cash flows were classified by the activities that created them. When directly creating a project cashflow statement, only two of the three activity-classifications that lead to flows of cash for a firm (Operating Activities and Investment Activities) are accounted for in the creation a project's cash flow streams. The Financing Activities, as discussed in Chapter 3, are typically not project-specific, but company-wide activities. As a result, the cash flows resulting from financing activities are ignored in project financial analyses performed in this book,

The appropriate measure for a project, which creates a level playing field for comparing all different types of projects, is to measure the present value of the project's future cash flows. It is, after all the present value of the future cash flow of the organization which drives the firm's total value, so measuring the impact a project may have on that present value is the appropriate measure. Two issues remain, however, that must be resolved before a project's present value be determined. We must ensure to resolve them in a consistent way so-as to make project-to-project comparisons impartial.

One issue that must be addressed in determining the present value of a future stream of cash is to determine the appropriate discount rate that should be employed on the project's projected future cash flows. This topic was discussed in Chapter 2. Most projects, as was discussed, will be discounted by incorporating the company's WACC (Weighted-Average Cost of Capital) into the project discount rage as the WACC incorporates all of a company's factors (inflation, risk, etc.). It can be argued, however, that the since the firm's WACC represents the firm's average risk across the entire company and any individual project could have risks in excess of the company's average. Different firms have different views on this. As a result, some firms choose to assess projects by either discounted them using the firm's WACC as the discount rate or by utilizing a project "hurdle rate." This so-called project hurdle rate is typically the firm's WACC plus some small differential, often 1%-2% above the firm's WACC. What is critical, however, if we are to create a level playing field for project comparisons, is that the project discount rate be the same for all projects being assessed.

The second issue is that we need to address in project valuation is time. Over what future period of time will we evaluate this project? If we are going to compare the potential value-creation of multiple projects we need to decide over what period of time to evaluate them. The project comparison playing field cannot be level if we assess one project over 10 years and another over 5, for example. When valuing a company, one assumes the company will go on forever. The time period over which the value of a firm is evaluated is, quite literally, infinity. Projects, on the other hand, have a finite timeline. Every company will have their own standard time-line they use to financially compare projects, but 10 or 15 years are the two most common, with a 10-year period being by far the most common. That means, most often, firms will be valuating a project over a ten-year period into the future.

Present and Future Values

Chapter 2 discussed how discounting future values back to the present could be thought of as the inverse process of the growth of a present value into the future. Equation 2.5 of Chapter 2 is restated below as Equation 4.1.

$$PV_N = FV_N * DF_N \qquad \text{Eq (4.1)}$$

Where PV_N is the present value of a value "N" periods into the future and DF_N is the discount Factor for period "N." DF_N, represents the value of a unit of currency "N" periods into the future. That discount factor is based on the project's Discount Rate, D_r. That discount rate takes into account the time value of money, company-level investor risks and firms cost of money. Equation 2.6 of Chapter 2 is restated as Equation 4.2 below.

$$DF_N = \frac{1}{(1+D_r)^N} \qquad \text{Eq (4.2)}$$

Combining equations 4.1 and 4.2 yields Equation 4.3 below.

$$PV_N = \frac{FV_N}{(1+D_r)^N} \qquad \text{Eq (4.3)}$$

Where "D_r" is the appropriate discount rate per period
And "N" is the number of periods into the future

Utilizing Equation 4.3, the present value of any future cash flow stream in any period into the future can be determined as long as the project's Discount Rate is known. As just discussed, that discount rate is a matter of company policy but is typically either the firm's WACC (Weighted-Average Cost of Capital) or a project "hurdle rate" which is some differential (typically, 1%-2%) above the company's WACC.

Project Measured Value Definitions: DCF, NPV and IRR

Measuring the present value of the project's future cash flows allows for the consistent and unbiased financial project comparisons. The present value of any future cash flow stream is determined by discounting that future cash to the present (Equation 4.1). This discounting is done utilizing a discount factor as shown in Equation (4.2). That annual discount factor is dependent on both the discount rate (D_r) and the number of periods (N) into the future the cash is generated. It was further stated that project valuations typically take place over a period of ten years into the future. While the discount rate and annual discount factors are utilized to calculate the present value of the future cash in any future year (Equation 4.3), this is not the project-comparison measure we ultimately seek. The remainder of this section will define the measures we are interested in calculating in order to make project-to-project financial comparisons. The remainder of his section will define the terms and the next section will introduce their calculation. Chapter 5 will then go into much more detail regarding the creation of dynamic project financial models to calculate these values.

Let's begin by defining some terms. An **Annual Discounted Cash Flow** (Annual DCF) is the present value of future cash projected to be obtained in a period in the future. It is calculated utilizing Equation 4.3. Future cash flow projections will start in year 0, the present year, and proceed out into the future. As just mentioned, these forecasts typically extend 10 years into the future. Each year the future cash flow stream is discounted back to the present by multiplying the forecasted net cash flow for that year by that year's discount factor (Equation 4.2). The year-by-year application of those calculations results in a series of annual discounted cash flows (or DCF) as shown in Figure 4.1, below. The values in the last row of Figure 4.1 are called Annual DCF because they are the discounted cash flow values for each future year of the analysis. (Note that the discount factor for year 0 is always 1.0, as $1 today is worth $1 today.)

Discount Rate:	10%										
Year:	0	1	2	3	4	5	6	7	8	9	10
Net Cash Flow ($):	-50.00	10.00	11.00	13.00	15.00	16.00	15.00	12.00	18.00	13.00	13.00
Discount Factor:	1.0000	0.9091	0.8264	0.7513	0.6830	0.6209	0.5645	0.5132	0.4665	0.4241	0.3855
Annual Discounted Cash Flow ($):	-50.00	9.09	9.09	9.77	10.25	9.93	8.47	6.16	8.40	5.51	5.01

Figure 4.1. Project's Discounted Future Cash Flows

The creation of the dynamic spreadsheet of Figure 4.1 is detailed in the video "V4.1_Project_NPV_Calculations" and spreadsheet is the third tab of the "Project_Finance_Video_Spreadsheet_Compilation" workbook.

Cumulative Discounted Cash Flow definition. Adding up the Annual discounted cash flows would result in the Cumulative discounted cash flow. All of the annual DCFs can be summed together to obtain a total 10-year DCF. What is more common, however, is that the annual DCFs are added one-year-at-a-time as illustrated in the row of Figure 4.2, below, labeled "Cumulative DCF ($)." That year-by-year summation of the annual DCFs allows the cumulative DCF to be plotted over time, visually indicating where the time-frame where the project breaks even. Again, the calculations shown in Figure 4.2 will be detailed video entitled “V4.1_Project_NPV_Calculations.” More will be said about this later, but for now, the aim is to simply define the terms.

Discount Rate:	10%										
Year:	0	1	2	3	4	5	6	7	8	9	10
Net Cash Flow ($):	-50.00	10.00	11.00	13.00	15.00	16.00	15.00	12.00	18.00	13.00	13.00
Discount Factor:	1.0000	0.9091	0.8264	0.7513	0.6830	0.6209	0.5645	0.5132	0.4665	0.4241	0.3855
Annual Discounted Cash Flow ($):	-50.00	9.09	9.09	9.77	10.25	9.93	8.47	6.16	8.40	5.51	5.01
Cumulative DCF ($):	-50.00	-40.91	-31.82	-22.05	-11.81	-1.87	6.60	12.75	21.15	26.66	31.68
10-year NPV(10%)=	31.68										

Figure 4.2. Project’s Cumulative DCF and NPV

The **Net Present Value** (NPV) for a project is the cumulative DCF (discounted at a specific rate) for the time-period evaluated. The project’s 10-year NPV is equivalent to the Cumulative Discounted Cash Flow summed up from year zero through and including year 10. Both the Cumulative DCF and the project’s NPV are measured in currency values (USD, for example). Because the NPV is dependent on BOTH the discount rate and the time period over which the project is being evaluated, it is improper and incomplete to just say a project’s NPV is $X. The time period and the discount rate must be included in the NPV’s description. There are various ways to write this that includes both aspects. All these notations below are acceptable ways to short-hand describe a 10-year Net Present Value, discounted at 5%. My personal preferences are for either one of the top two on the list.

- NPV_{10}(5%)
- 10-year NPV(5%)
- NPV(10, 5%)
- 10-year NPV @ 5%

The 10-Year NPV(10%) of the project illustrated in Figure 4.2, above, is $31.68. The details of that calculation will be discussed in the next section.

The primary value we desire to measure to gauge the financial success of a project is the project’s NPV value. Complimentary to that value is the project’s rate of return. If you invested $1000 and five years later you had $2000 you could readily calculate the compounded annual rate of return (i.e. annual compounded growth rate) that would produce that result (14.89%; see “Chapter 4” tab in Excel® workbook “Project_Finance_Chapter_Spreadsheets_&_Templates.xls” for details).

Calculating a rate of return is a bit trickier for a project as the project costs continue over the project’s lifespan. The project equivalent to a “rate of return” is called the project’s **IRR,** the **Internal Rate of Return**. Although the project’s IRR calculation is rather straightforward, but may initially appear mathematically disconnected to its definition. The mathematics required to reconcile the two is beyond the scope of this text. As a result, for the purposes of this introduction, you will have to accept take on faith that the project’s IRR does truly represent the project’s rate of return.

The project's IRR (Internal Rate of Return) is the discount rate at which the base-case project NPV is equal to zero. As the discount rate increases, the present value of future cash flows decreases. For project's that had a positive base-case net present value, the project's present value will therefore decrease as the discount rate increases. The discount rate which cause the project base-case NPV to equal zero is its IRR. For the example that is illustrated in Figure 4,2, the base-case 10-year NPV(10%) = $31.68. This base-case has an internal rate of return, IRR, of 22.3%. In other words, increasing the discount rate from its original value of 10% to a value of 22.3% results in the 10-year NPV = 0. The details of this are discussed in the next section and on the Video "V4.2_IRR_using_Goal_Seek" For now, simply accept the definition that the IRR of a project is the discount rate which forces the base-case NPV to be zero.

Calculation(s): DCF, NPV and IRR (an introduction)

This section will introduce the calculation of a project's NPV starting with a future net cash flow stream projection. The next chapter, Chapter 5, will discuss how to build a year-to-year project cash-flow model. Both parts are necessary to obtain the project's net present value, but separating the process into two components will hopefully help the digestibility of the process.

This section and the accompanying video, "V4.1_Project_NPV_Calculations" will start with a projection for the project's net cash flow over time. From there, the annual and cumulative discounted cash flows will be calculated. The project's net present value is then determined. The project's IRR, internal rate of return, is then determined for the base-case presented in this example utilizing Excel's "Goal Seek" function. That IRR calculation is presented in video, "V4.2_IRR_using_Goal_Seek." The spreadsheets associates with these videos are included in the Excel® workbook entitled "Project_Finance_Video_Spreadsheet_Compilation.xls."

The previously-discussed Figure 4.2 shows a dynamic spreadsheet for discounting future cash flows. The color blue has been used for the discount rate value to indicate that it is a changeable input variable. The "Net Cash Flow" values are fixed and the remaining cells are calculated so these values are all in black. Notice that in year zero (present) the "discount factor" is 1.000. A dollar today is worth a dollar today.

In this example we are spending $50 today in hopes of earning more money in the future. That's the essence of most projects. Spending money up-front to make money in the future. The question that remains to be answered is do we make enough in the future to justify the up-front investment? In Figure 4.2, we have projected the net cash flow (income less costs) we hope to obtain in future years. The discount factor for each year in the future is calculated using the 10% discount rate. Finally, the Annual Discounted Cash Flow (Annual DCF) is calculated for each year by multiplying the discount rate for each year by the projected net cash flow for that year.

If we add up the **un**discounted Net Cash Flow values for years 1 through 10, you can see they add up to $136. This makes it appear that by spending $50 we could earn $136, or an increase of $86 above our investment. That would make this a good project, right? Not really. As discussed, due to time value of money and risk, a dollar in the future is not worth the same as a dollar today. Without first appropriately discounting the projected future cash we hope to obtain it is too soon to tell if the present values of the future cash that the project is projected to earn is more or less than the present value of the investment required for this project. As a result, we first need to discount each of those future cash-flows before adding them up. Adding up all of the Annual DCFs (from year 0 through and including year 10) will produce a number that brings everything to the value of today's dollars.

Calculation Overview: Cumulative DCF, NPV and IRR

The annual Discounted Cash Flows (DCFs) from Figure 4.2 will be added to determine the Cumulative DCF, but will do so in two steps. First, we will add a line to our dynamic spreadsheet, Figure 4.1, that adds up all the annual DCFs year-by-year. This row is now the Cumulative DCF value of Figure 4.2. For year 0, the cumulative DCF is just the DCF for year 0. For year 2 the Cumulative DCF is the sum of the annual DCFs for years 0, 1 and 2. The model can be extended indefinitely into the future, but since companies look at the value of projects over a fixed time period, usually 10 years, the analysis will terminate then.

The **Net Present Value** (NPV) for a project is the cumulative DCF (discounted at a specific rate) for the time-period evaluated. In our case the 10-year NPV(10%) = $31.68, which is the same as the cumulative DCF for year 10. Note that in Figure 4.2 that the 5-year NPV (10%) would be -$1.87 (the same as the cumulative discounted cash flow for year 5). The negative value indicates that, after five years, the present value of the project is still negative. This means that the amount that the project gained (in present dollars) through year five has not yet equaled the amount spent up-front on this project. Since the Cumulative DCF in Year 6 of our example of Figure 4.2 is a positive value ($6.60) then we know that the project will break even (on a present value basis) sometime early in Year 6 (as the project is negative at the end of year 5, but is positive by the end of year 6).

The video on how the Figure 4.2 dynamic spreadsheet was created is named "V4.1Project_NPV_calculation." Note that the spreadsheet is truly dynamic in that when the discount rate is changed that both the NPV value and the NPV's label changes. Excel makes it fairly easy to create dynamic labels for variables. Labels are critically important to any spreadsheet, of course, but dynamic labels help them accurately reflect what is truly being represented. It is far too easy to forget to change an important label of the spreadsheet if you need to do it manually every time an input variable is changed. The video will describe how to make this occur automatically

Now that we know the project's NPV. We now know that the 10-year NPV(10%) is $31.68 which means that in today's dollars and including cost of money and risks, we have $31.68 more by doing this project than by doing nothing (doing nothing NPV=0). Any project NPV that is greater than zero suggests that the project is financially viable. What is left to determine is the project's IRR (internal rate of return) for this 10-year NPV(10%). Recall that IRR is equivalent of the project's investment return rate. It is calculated by determining the discount rate at which the NPV (10-year in this case) is equal to zero. This is a non-linear, trial-and-error calculation. Fortunately, Excel® has a function called "goal seek" that does this work for you. Video "V4.2_IRR_using_Goal_Seek" will illustrate, step-by-step, how to use Excel's "goal seek" function to calculate an IRR.

Chapter Summary

To summarize this chapter we will return to the to the QMCR[3] mnemonic. If the question is related to a project's viability, then the appropriate measure is the to determine the project's Net Present Value. The NPV is equal to the cumulative discounted cash flow (cumulative DCF) over a period of time. The calculation of a project's NPV requires two foundational attributes. One is the discount rate. That is, the rate at which future cash flows will be discounted so that we can determine the present value of those future cash flows. The second attribute is the number of future periods over which the project will be valued (5 years, 10 years, more?). This is why saying a project's NPV is incomplete, it needs to be X-year NPV(Y%). In other words, an NPV calculated X-years into the future using a discount rate of Y%.

That discount rate for a project is often the company's WACC (Weighted-Average Cost of Capital). The WACC represents the "cost of money" for a firm and reflects both the inflationary attributes of the time value of money plus the specific corporate-average risks (from an investor point-of-view). Given that the WACC represents corporate-wide average risk for future endeavors, some companies discount specific projects at a rate slightly higher than their WACC, a so-called project "hurdle rate." These hurdle rates are usually 1% to 2% higher than the corporate WACC.

Q: Is this project worth doing?
M: Measure the project's base-case NPV. This measurement must be over a clearly stated period of time into the future at a clearly stated discount rate.
C: Do the calculation as shown in figures and described on the "V4.1_NPV_Calculation "video.
Q: What is the project's expected return rate?
M: Measure the project's IRR (internal rate of return), based on the project's base-case NPV.
C: Use Excel's "goal seek" function to determine the discount rate for which the 10-year NPV (if that was the base-case measure) is zero. The result of that is the base-case project IRR. (See "V4.1_IRR_using_Goal_Seek" for details.)

Conclusion: If the project's NPV is >0 then the base-case analysis of the project indicates that project makes financial sense. A project NPV greater than zero means that the present value of the project is greater than doing nothing (which would yield an NPV equal to zero). If the NPV is negative, the firm is worse off doing the project than doing nothing (given the base-case assumptions). However, this analysis does not yet mean that we should go-ahead and execute this project. We have, to this point, only performed a financial screening of the project. We have not yet determined, for example, the project input values that cause the most variability in the project's NPV. We also do not yet know the "success boundary conditions" of this project. Or in other words, under what conditions will this project be financially viable. Yes, we know the project is financially viable given the base-case assumptions, but that only tells us that the project is worthy of more detailed assessment. That second-level assessment will be covered in Chapter 6.

<u>Conclusion</u>
While there are many questions that can be posed for any given project the two foundational questions are: (1) Is the project financially viable. In other words, does it produce more money that it costs to execute the project? If the project has a positive NPV, then the project passes its initial evaluative screen.

For those projects, second-level questions now need answers. The second foundation questions (2), are under what conditions is the project financially viable? This second-level question is related to identifying a project's success boundary conditions which will be addressed in Chapter 6 where the project's sensitivity analysis will be performed. In the interim, Chapter 5 will detail how to create a dynamic project financial model from scratch using Excel®.

CHAPER 5: PROJECT FINANCIAL MODEL BUILDING

This chapter will describe the details necessary to create a financial model for a project. In the last chapter, we cheated a bit by starting with the project's net cash flow. Doing so allowed us to focus on the discounting process which leads to the calculation of the project's discounted DCF (discounted cash flow) (both annual and cumulative), NPV (net present value) and the IRR (internal rate of return). In this chapter, and the associated video (V5.1_Project_Financial_Model_Building), the actions that lead up to the project's net cash flow will be articulated. A specific example, first introduced in Chapter 1, will be detailed and utilized to describe the step-by-step process of building a dynamic financial model for a project. That same example will be carried forward into Chapters 6 and 7, that discuss sensitivity analysis and report-writing, respectively.

The statement of cash flows (C/F statement) is usually constructed from the organization's income statement (I/S) and balance sheet (B/S). The annual C/F is the firm's annual net cash from the income statement, plus depreciation (if it was included as a "cost" in the I/S) minus increases in the firm's Balance Sheet items. The cash flow streams are typically organized into three categories based on the activities that created them: Operating Activities, Investment Activities and Financing Activities. In project financial analysis we are only concerned cash flows directly attributable to the project. Financing activities, are generally corporation-wide activities, and as a result, are not project specific. In this text, the cash flows due financing activities are ignored in our project financial assessment. If however, the organization's project financing varies drastically from project to project (which may be the case in some non-profit or governmental organizations), then these associated cash flows will need to be incorporated into the analysis. For the purposes of this book, however, the variation in finance costs from project to project are assumed to be legible and are therefore ignored.

Starting with a blank spreadsheet is probably as intimidating for a financial modeler as staring at a blank word document is for a writer. To avoid that writer's block, we will begin with an Excel® Project NPV Analysis Template. This template is located in the second Excel® workbook that accompanies this text: Project_Finance_Chapter_Spreadsheets_&_Templates.xls. The compilation of spreadsheets utilized in the supporting videos, on the other hand, are in the Excel® workbook entitled: Project_Finance_Video_Spreadsheet_Compilation.xls.

If asked to financially evaluate a project then we know we will be calculating a Net Present Value. Toward that end we will need to calculate annual Discounted Cash Flows (DCFs). That means will need to calculate annual discount factors from the discount rate. Prior to that we'll need Annual Cash Flows to discount. Those annual cash flows will be derived from annual Revenue, Costs and Investments. There is a lot we know without knowing anything about the specific project we will be evaluating. Indeed, we do not have to start with a "blank" spreadsheet, but with a "generic" project template (see Figure 5.1, below). Yes, rows may need to be added or deleted, but staring with *some*thing is always easier than starting from nothing.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
1	**Project NPV Analysis Template**																		
2																			
3		Input Table																	
4			Discount Rate:	0.0%															
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14			Project Year:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
15		Income																	
16			Units Sold:																
17			Price per unit ($):																
18			Revenue ($):																
19																			
20		Operating Costs																	
21			COGS ($):																
22			SG&A ($):																
23			Maintanance ($):																
24																			
25		Investment																	
26			Capital Expenditure ($):																
27																			
28		Totals																	
29			Annual Net Cash Flow ($):	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30			Discount Factor:	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
31			Annual DCF ($):	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
32			Cumulative DCF ($):	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
33																			
34			10-year NPV(0%) =	0															
35																			
36			IRR of 10-Year base-case (%) =																
37																			

Figure 5.1: Generic Project NPV Analysis Spreadsheet

In this dynamic template the annual discount factor cells (row 30) are already linked to the discount rate cell (D4) and the associated Project Year in Row 14. The annual and cumulative DFC calculations formulas are pre-entered in the cells of row 31 and 32, respectively. The 10-year NPV dynamic label is linked to the discount factor (cell D4). The 10-year NPV (discount rate) value is also linked to the appropriate cell in the cumulative DCF line (row 32). This NVP value link and NPV label can be easily changed if a 5 or 15-year NPV is preferred over the 10-year one of this template.

A project financial model that will develop a project net cash flow, year-by-year, will be developed for a specific example in the remainder of this chapter. The step-by-step development of this dynamic financial model for the example project is further described in the video "V4.1_Project_Financial_Model_Building." The spreadsheet utilized in this video is in the workbook: Project_Finance_Video_Spreadsheet_Compilaiton.xls. In Chapters 6 and 7, the example of this chapter will be continued. A sensitivity analysis, using the model created for the example in this chapter, will be performed in Chapter 6. That sensitivity analysis will allow us to tease out the example project's risks and conditions under which the project can be financially viable. A series of three videos will illustrate the step-by-step actions of the process described in Chapter 6. Those videos are "V6.1_Tornado_Diagram_Input_Table_Creation," "V6.2_Tornado_Diagram_Graphic_Creation," and V6.3_Project_Success_Conditions." Chapter 7 will pull all of the analysis together by providing an example of a detailed project financial analysis report based on this same example.

Example

The example that was briefly introduced in Chapter 1 is more fully developed in the this and the next chapter. An example report, based on the project analysis performed, is then be detailed in Chapter 7. We will build this year-by-year project cash flow using the NPV Project Analysis Excel® Template shown in Figure 5.1

Recall from the Chapter 1 that you work for a specialty chemical company with annual revenues of $50 million. That firm is seeking to expand. Since the firm is currently selling everything it can produce, it must expand production capacity in order to grow sales. As a result, what is being proposed is a production expansion project. This capital investment for this project is estimated to be $4.75 million, according to the engineering study. The expansion would allow the company to increase sales, albeit not all at once. The market research study suggests that that company's overall revenues could increase by an additional 20% of its current value with this expansion, although that revenue increase is estimated to occur over five years. The market research report assumes a linear growth in sales over those five years. After that point, the firm's sales would again match the firm's production capacity, so no further sales growth would occur.

The firm's CFO has asked you to "run some numbers" on the expansion. Specifically, she has asked you to calculate the project's pre-tax 10-year NPV of the free cash flow associated with this project. You know from doing financial projects for the firm before, that the firm prefers to calculate the NPV at a project "hurdle rate" which is 1% higher than the company's WACC of 6.7%. You also know that the construction costs will be recorded in "Year 0" and the incremental revenue increase, due to the production expansion, will begin in Year 1. Standard practice in this company is to include annual facility maintenance costs to any capital project. The standard company rate for this annual maintenance cost is 5% per year of the project's initial CapEx (Capital Expenditure). The CFO has specifically asked you to ignore any increases to the firm's working capital that may occur as a result of the expansion. You further know that the firm typically uses a 20-year straight-line depreciation for capital investments, but since you have been asked to calculate the project's cash flow you know that depreciation is a non-factor.

Here's what you also know about firm's product costs, which are not anticipated to change with the expansion. (The company has no on-going R&D costs.)

COGS Margin: 79.1%
SG&A Margin: 4.3%

OK, this is a lot of information that we will need to sort out and plug into the project analysis template. The goal is to first get all the information into the spreadsheet first, then focus on making it a "dynamic" spreadsheet later, so that we can do "what if" scenario analyses. Once your experience level rises you can do both at the same time, but separating the process into two steps will make it less overwhelming.

Discount Rate

Let's start with the discount rate. We now know the firm's WACC (6.7%) and the differential rate (1%) above the WACC that the firm uses for the discount rate for project analyses. We therefore know we will be using a discount rate of 7.7%. Let's put both the WACC and the "project hurdle rate differential in the "input table" of our template spreadsheet, as the CFO may ask us 'what if the discount rate is 2% higher than the WACC?" or "what if our WACC changes to…"

Invested Capital

Next let's address the capital invested in this project (often called CapEx which is short for Capital Expenditures). That capital expenditure will fall into the "PP&E" category (Plant Property and Equipment). We therefore know that the project will change the Company's PP&E by the amount of the project's CapEx. The synopsis says that the CapEx is estimated to be $4.75 million. We need to make a couple of decisions before we start putting $-values into the spreadsheet. One is the scale of currency-value entries. Will the spreadsheet currency-based inputs and outputs be in dollars, thousands of dollars ($'000) or millions of dollars ($m)? Whatever we choose, we need to be consistent throughout the spreadsheet. For simplicity, in this example, we'll choose the inputs in US Dollars (USD). The CapEx value will go under Year 0 in the "capital expenditures" row of the spreadsheet (under the "Investment" header). Which brings us to our next issue: should the value be entered into that cell as a positive or negative number? Neither is wrong, but how the value is entered depends on how the "Annual Net Cash Flow" line is calculated. If that line is a sum of revenue and costs, then the costs need to be entered as negative values. If that line is calculated as the revenue minus the costs (including the capital expenditures), then those "cost" values need to be entered as positive numbers. It is important to know which is which, especially when using a template created by someone else. In the generic "Project NPV Analysis Template" spreadsheet, which we are utilizing for this example, the "Annual net cash flow" values (row 29) are calculated as the revenue minus the costs; which means that all costs (including the capital expenditures) must be entered into this template as positive values.

We can certainly enter the capital investment value ($4.75 million) as $4,750,000 value in the cell under Year 0 of the "Capital Expenditures" (row 26 of Figure 5.2). The final point related to the capital expenditure is that we know that we will certainly be asked "what-if" questions around that CapEx value. "What if there are cost overruns in the construction?" "What if the expansion comes in under budget?" We should therefore put the "Expansion Capital Investment" as part of the input table we are creating and then link that value in the input table to the appropriate cell in Row 26 (see video V5.1_Project_Financial_Model_Building" for the step-by-step process to build this dynamic financial model).

With the discount rate and expansion capital in place (and inserted into the "input table") the NPV Project Evaluation spreadsheet should now look something like Figure 5.2, below.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1	**Creating a Project Cash Flow Spreadsheet**																			
2																				
3		Input Table:																		
4			WACC (%):	6.7%																
5			Hurdle Rate above WACC (%):	1.0%																
6			Discount Rate:	7.7%																
7																				
8			Expansion Capital Investment ($):	4,750,000																
9																				
10																				
11																				
12																				
13																				
14																				
15																				
16			**Project Year:**	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	
17		Income																		
18			Revenue ($):		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
19																				
20		Operating Costs																		
21			COGS ($):		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
22			SG&A ($):		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
23			Maintanance ($):		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
24																				
25		Investment																		
26			Capital Expenditures ($):	4,750,000																
27																				
28		Totals																		
29			Annual Net Cash Flow ($):	-4,750,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
30			Discount Factor:	1.0000	0.9285	0.8621	0.8005	0.7433	0.6901	0.6408	0.5950	0.5524	0.5129	0.4763	0.4422	0.4106	0.3812	0.3540	0.3287	
31			Annual DCF ($):	-4,750,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
32			Cumulative DCF ($):	-4,750,000	-4,750,000	-4,750,000	-4,750,000	-4,750,000	-4,750,000	-4,750,000	-4,750,000	-4,750,000	-4,750,000	-4,750,000	-4,750,000	-4,750,000	-4,750,000	-4,750,000	-4,750,000	
33																				
34			10-year NPV(7.7%) in USD =	-4,750,000																
35																				
36			IRR of 10-Year base-case (%) =																	
37																				

Figure 5.2: Initial Completion of Project NPV Analysis Spreadsheet

Revenue

The next step is to work on the on-going revenue and operating costs. Both of these inputs will need to be generated year-by-year. Since the operating costs are revenue-dependent, we'll start with the revenue. The revenue is presented to us in an unusual way. The current company revenue is $50 million and the plant expansion is expected to increase revenue by 20% of the current company's revenue value. Furthermore, that revenue increase will be realized over time. Let's break this down and initially deal with the maximum revenue increase that we anticipate this project will achieve.

We only want to give this project credit for revenue generated by the expansion, not the current company's total revenue. The company is currently making $50 million per year and that can be expected to continue whether or not this expansion project proceeds. That means that the "revenue" associated with this expansion project is the 20% of that $50 million or $10 million ($50*0.2). Since the projection was for revenue to increase by 20% of the current firm's revenue, than it is that variable – the 20% -- and not the $-figure ($10 million) that will likely be the subject of the "what-if" questions. ("What if that revenue increase is only 18% of the company's current revenue, etc.?) We therefore want that appropriately-labeled 20% figure to be in the input table.

The revenue is expected to grow to this maximum of $10 million over a 5-year period. That's $2,000,000 per year revenue increase ($10 million divided by 5) until the total annual revenue reaches the maximum of $10 million. However, we may want to examine what happens if it takes 7 years to grow that revenue versus the 5 that is conjectured. Accordingly, we will also keep that time a variable in our input table. The video "V5.1_Project_Financial_Model_Building" walks through, step-by-step how to make that happen.

Operating costs

The operating costs include the “Cost of Goods Sold” (COGS), the “Sales, General and Administration” (SG&A) costs and the maintenance costs. (The “maintenance” costs are, in this example, the “other” costs that are sometimes included in SG&A costs. Many companies track that as a separate line-item and do not roll it up into SG&A costs. In this example, the SG&A costs quoted do not include maintenance.) The COGS and SG&A costs (less maintenance) are provided as COGS and SG&A Margins, or in other words, as a percent of revenue. That means that if we put the COGS and SG&A Margins in the input table we can use them to calculate the costs in any given year. The only potential wrinkle here is that if this were a new product, we would probably have to have administration and sales people in place BEFORE we start recording product sales. If that were the case, we may want to start SG&A costs a year before the product is ready to sell by recording the year 1 SG&A costs in the year 0 column. However, this is an expansion of a product the company already produces. The company, therefore, is already operating with a full staff, so any new costs would be incremental and dependent on the increased sales. We therefore only need to record the operating costs, in this example, in years 1 through 15.

The last on-going operation-related cost is plant maintenance. The company standard, we are told, is to charge 5% of the invested capital per year for the estimated annual facility maintenance cost. We’ll add that 5% variable to the input table just in case someone askes “what if” that changes. Again, the “V5.1_Project_Financial_Model_Building” video walks through these details.

Note that the “Annual Net Cash Flow” row in Figure 5.3 is precisely what was described in Chapters 3 and 4:

Project Cash Flow =

EBITDA
- Increases in PP&E
- Increases in Working Capital

The project EBITDA value, in this case, included the maintenance costs as “other” indirect costs. (Revenue – COGS – SG&A – Maintenance costs). The increases in PP&E were due to the capital investment. Finally, in this example, we were specifically instructed to ignore changes in working capital so that line-item is ignored.

Completed Dynamic NPV Project Analysis Spreadsheet

We now have a completed the base-case of this project’s financial analysis as illustrated in Figure 5.3. The project 10-year NPV(7.7%), incorporating all the base-case assumptions, is shown to be just over $2 million.

Creating a Project Cash Flow Spreadsheet

Input Table:			
WACC (%):	6.7%		
Hurdle Rate above WACC (%):	1.0%		
Discount Rate:	7.7%		
Expansion Capital Investment ($):	4,750,000		
Current Company Revenue ($):	50,000,000	COGS Margin (%)	79.1%
% of Revenue Increase from Expansion:	20%	SG&A Margin (%)	4.3%
Total Revenue Growth ($):	10,000,000	Annual Maintenance (% of Capital):	5.0%
Years over which Revenue will Grow:	5		
Revenue Growth per Year:	2,000,000		

Project Year:	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Income																
Revenue ($):		2,000,000	4,000,000	6,000,000	8,000,000	#########	#########	#########	#########	#########	#########	#########	#########	#########	#########	#########
Operating Costs																
COGS ($):		1,582,000	3,164,000	4,746,000	6,328,000	7,910,000	7,910,000	7,910,000	7,910,000	7,910,000	7,910,000	7,910,000	7,910,000	7,910,000	7,910,000	7,910,000
SG&A ($):		86,000	172,000	258,000	344,000	430,000	430,000	430,000	430,000	430,000	430,000	430,000	430,000	430,000	430,000	430,000
Maintanance ($):		237,500	237,500	237,500	237,500	237,500	237,500	237,500	237,500	237,500	237,500	237,500	237,500	237,500	237,500	237,500
Investment																
Capital Expenditures ($):	4,750,000															
Totals																
Annual Net Cash Flow ($):	-4,750,000	94,500	426,500	758,500	1,090,500	1,422,500	1,422,500	1,422,500	1,422,500	1,422,500	1,422,500	1,422,500	1,422,500	1,422,500	1,422,500	1,422,500
Discount Factor:	1.0000	0.9285	0.8621	0.8005	0.7433	0.6901	0.6408	0.5950	0.5524	0.5129	0.4763	0.4422	0.4106	0.3812	0.3540	0.3287
Annual DCF ($):	-4,750,000	87,744	367,695	607,167	810,518	981,689	911,503	846,335	785,826	729,644	677,478	629,042	584,069	542,311	503,538	467,538
Cumulative DCF ($):	-4,750,000	-4,662,256	-4,294,561	-3,687,394	-2,876,876	-1,895,187	-983,684	-137,349	648,478	1,378,121	2,055,599	2,684,641	3,268,710	3,811,021	4,314,559	4,782,097
10-year NPV(7.7%) in USD =	2,055,599															
IRR of 10-Year base-case (%) =	14.38%															

Figure 5.3: Completed Project NPV Analysis Spreadsheet

What the approximately $2 million base-case 10-year NPV(7.7%) reveals is that the project will make the firm money, as long as all the base-case assumptions hold true. Despite a hefty price-tag for the expansion ($4.75 million) the present value of this project (including that investment) is over $2 million. That means the company is $2 million better off (today) by deciding to do this project versus not doing it. The project's IRR (internal rate of return) for this 10-year NPV is 14.4%, which is a very healthy return, is yet another positive attribute of this base-case scenario. (Note the details of how the IRR is calculated, in general, is demonstrated in video "V4.2_IRR_using_Goal_Seek." The IRR calculation for this specific project is detailed as part of video "V6.3_Project_Success_Conditions.")

The recommendation, based on this base-case analysis alone, would be a "go" for the project. However, we are not ready to make that recommendation yet. The base-case analysis is only the initial financial screen. Given that it is positive, the project has earned the privaledge move on to more detailed analysis. If this value were negative, then the project would be denied in its current form and the originators given the option of changing the project proposal. Given that the base-case NPV is positive, we need to dig deeper. We still do not know what drives the project's financial risks, for example. That will be the subject of the next section.

The Cumulative DCF scatter-plot (Figure 5.4, below) shows that the base-case project breaks even approximately in year 7. (This can also be seen in row 32 of Figure 5.3.)

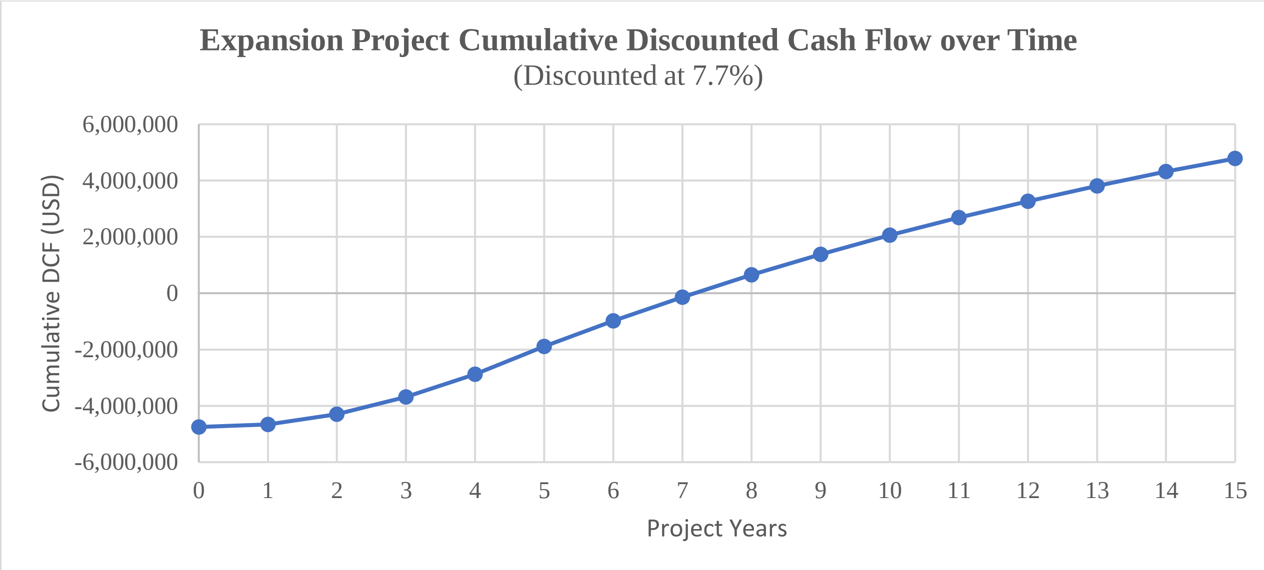

Figure 5.4. Cumulative Discounted Cash Flow over Time

The goal of a complete analysis, however, was not to generate a single answer. That single answer is simply the project's initial financial screen. We want to generate insight as to what makes this project tick. Where are the risks? What aspects of the project should we be sure about before proceeding? The financial model we have built is the STARTING point to gaining that insight. By creating a dynamic spreadsheet, as we have done, or in other words, having built a dynamic financial model, we are in great position to run a variety of "what if" analyses. Those "what if" analyses is what will lead to the insight into the project's primary risks that we seek. Those further analyses, which will utilize the dynamic spreadsheet of Figure 5.3, is the topic of the next chapter.

Chapter Summary

In this chapter we built a year-by-year project financial model for a specific example project. We utilized the Project NPV Analysis Template that is included with this book as a starting point. Our aim is not to simply calculate a single NPV value for this project, but to build a dynamic financial model which we will use to perform what-if analyses. As a result, we created an input table, above the main calculation section of the spreadsheet, that contains the variables we believe we may want to later vary.

The building of the financial model began with the input variables that did not vary year-to-year: discount rate and capital expenditure. The year-to-year values were then added, beginning with revenue, as many of the other annual costs are expressed as a percent of revenue. The step-by-step guide to create this project's financial model is detailed in the "V5.1_Project_Financial_Model_Building" video.

The base-case project 10-year NPV(7.7%) of approximately $2 million with an IRR of 14.4% indicating that the base-case project, presuming all of the project's initial assumptions are correct, is financially viable. What remains to be determined is the risks associated with this project. Attaining that insight is the subject of Chapter 6.

CHAPTER 6: PROJECT SENSITIVITY ANALYSIS

The prior chapter detailed the creation of a dynamic spreadsheet to calculate the example project's 10-year NPV. A dynamic spreadsheet was created as we were not simply looking for a single number answer, but *insight* into what that number was most dependent upon. That is financial management. The firm cannot properly manage the project's elements that driving the project's success if they don't know what those elements are!

This chapter will move beyond the project's financial screen to focus on the sensitivity analysis. The dynamic model that was created in the prior chapter is utilized in this chapter to tease out the project's vulnerabilities. We are seeking insight. Insight regarding the project's risks and the conditions beyond which this project is no longer financially viable (success boundary conditions). This chapter will illustrate those concepts by continuing the project example of Chapter 5. Details of the analyses of this chapter, plus the creation of graphics necessary to allow us to more easily communicate our findings, are described in three videos. They are:

V6.1_Tornado_Diagram_Input_Table
V6.2_Tornado_Diagram_Graphic_Creation
V6.3_Project_Success_Conditions.

The spreadsheets discussed in those videos are identified as individual tabs of the Excel® workbook: Project_Finance_Video_Spreadsheet_Compilaiton.xls.

Example

The specific project example we have been detailing was briefly introduced in Chapter 1. In the prior chapter (Chapter 5) we created a dynamic NPV model for this project starting from an Excel-based "Project NPV Analysis Spreadsheet." That spreadsheet, as are all non-video related spreadsheets used in this text, are tabs of the Excel® workbook: Project_Finance_Chapter_Spreadsheets_&_Templates.xls. We will build upon the effort of the previous chapter to perform sensitivity analyses on the project, starting with the dynamic spreadsheet created in Chapter 5.

Recall that the project is for a specialty chemical company with annual revenues of $50 million. That firm is seeking to expand. Since the firm is currently selling everything it can produce, it must expand production capacity in order to increase its sales and, as a result, its revenue. Correspondingly, what is being proposed is a production expansion project. This capital investment for this project is estimated to be $4.75 million, according to the engineering study.

The CFO's "gut feel," based on her experience at the firm, is to suspect the validity of the marketing numbers. She therefore wants to do a project sensitivity analysis around that particular variable. We will do this, of course, as that's what our boss has requested, but we can and need to do *more*. As financial analysts, we are not limited to "gut feel." We have the tools to allow us to peer into the future. As a result, we can look at the project's sensitivity to a number of different input variables and see where the project's major risks may lie. Doing so not only makes us an invaluable asset to the firm, it is our fiduciary responsibility to do so.

<u>Tornado Diagram Introduction</u>

We must always keep in mind that the information we are creating must be presented in a way that is easily understood by the organization's decision-makers. These decision-makers may not be "numbers people" and, as a result, will be easily overwhelmed with tables of numbers. We therefore seek an easy visualizer for identifying and prioritizing the sensitivity of the input variables critical to the project's outcome. A so-called "tornado" diagram is one way to present this information. A tornado diagram (here in the VI we should call it a "hurricane" diagram), is a way to graphically represent the relative impact that a variety of input variables have a project's outcome. That outcome can, as we have seen, be measured in a number of ways. For companies, we may look at the overall company's value or stock price, but for a project the "measure" we are usually interested in is the project's present value… its NPV (Net Present Value). When performing sensitivity analysis, we are particularly interested in how the project's NPV may change – relative to the project's base-case NPV – if the inputs values differ from what was initially assumed in that base-case scenario.

Figure 6.1, is a tornado diagram for the Enterprise Value of a firm. The "tornado" name comes from the "funnel" shape the bar graphs make. The graphic is a visual representation of the listing of the input variables that drive the most variability in the measured output value (EnV in this graphic). Each bar represents the change that one input-variable change has on the measured outcome. The changes in the output measure (EnV, in this graphic) are measured as a % of the base-case output value. The further the bar-graph extends from the center line (the base-case value), the larger the impact of change to the input-variable has on the measured output value. Bars that extend to the left indicated a negative impact, while bars that extend to the right indicate a positive impact. The top bars of Figure 6.1 indicate that the low value of a range Revenue's ACGR (annual compounded growth rate) input values, would drop the firm's Enterprise Value (EnV) to 68.2% of its base-case value. At the other extreme, increasing the Revenue's ACGR to the highest value of the assessed range would cause the firm's EnV to be 128.6% of its base-case value.

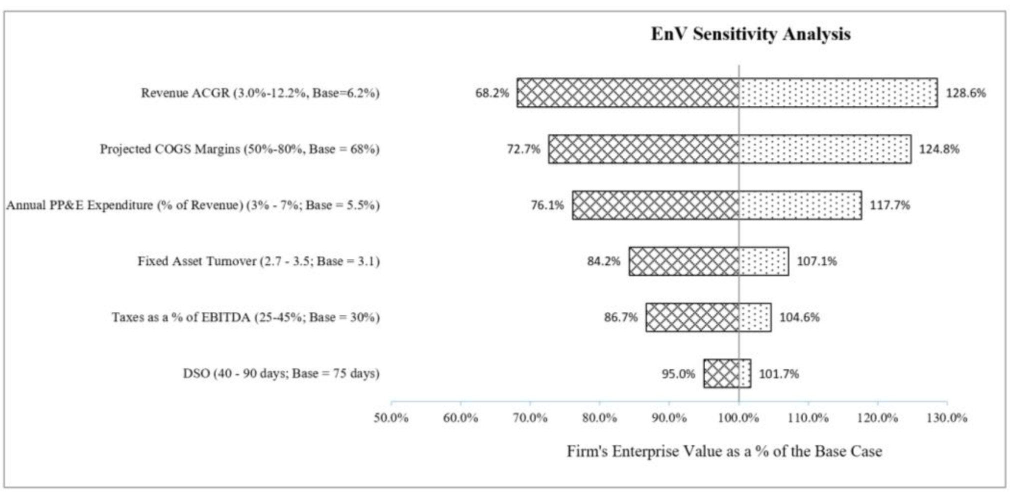

Figure 6.1. Tornado Diagram for Enterprise Value of a Firm

The graphic shows decreasing impact—from top to bottom—that input variable changes have on the model's output. Changes in the input variables shown at the top, the widest part of the "funnel" create the largest variation in the output. The length of the bars are a visual representation of the range outcomes that the range of input variable create. As mentioned, the top of Figure 6.1 the "Revenue's Annual Compounded Growth Rate (ACGR)" over the range assessed has the most impact on the firm's enterprise value. At the bottom of the diagram, the variability in the DSO (Days Sales Outstanding), over the range assessed for that input-variable, generates the least changes to firm's Enterprise Value in this case.

Another way of viewing this diagrams is that those input-variables at the top of the tornado diagram represent the most risk to the project. If any of these input-variables stray off their predicted (base-case) values, the result will be a significant impact on the measured output. The input-variables that create the most variability in the output are the elements management needs to focus on, while the ones at the bottom are less influential and therefore less critical.

Tornado diagrams allow managers to visually identify, and therefore focus in on, the important input-variables (those at the top of the chart) and allow them to know which they need to pay less attention (those at the bottom). If we are managing the company represented in Figure 6.1,in an effort to maximize the firm's Enterprise Value, this tornado diagram tells us that we need to pay close attention to, and try to maximize, the company's Revenue ACGR. We now further know that we do not have to worry much about the Days Sales Outstanding, so can spend much less of our time managing that issue.

<u>Project Tornado Diagram Development</u>

We will be creating a tornado diagram, for the example project of Chapter 5, using the project's 10-year NPV as the appropriate output measure. That diagram will tell us, among other things, if the CFO's "gut feel" is correct. It may also reveal other parameters, critical to the success of the project, that the CFO is not currently thinking about. That's insight. Once we have identified where the project risks are, we can craft a strategy to mitigate those risks; but only if we first know the source of the risks.

We made a number of assumptions, regarding a number of input-variables, in creating our base-case NPV projection in the last chapter. Now we need to decide which variables to include in our sensitivity assessment and over what range of each input-variable should we consider. We will then calculate the project NPV for the high and low value of each input-variable and compare those results to the project's base-case NPV.

Developing an appropriate "range" for each input-value is not a trivial exercise. In reality, it requires some research on the analyst's part. The "high" value selected for each variable should be one beyond which the variable is not likely to rise above. That does not mean we make it "huge," on the contrary, we want it to be as low as possible but still represent the "high." For example, if I was doing a study in which the local temperature was an input value, what would I consider to be the "high" end of that range. Here in St. Thomas in the USVI, our "high" temperature rarely exceeds 90º Fahrenheit; it exceeds that value less than a half-dozen times per year, on average. I might then use 90ºF to describe the "high" or maybe a few degrees above that. I would <u>not</u> use 150ºF, because I know that the temperature would never exceed that value. Ranges should be representative of what could be considered "high" and "low" not unrealistic extremes. These ranges are important and take some experience to develop accurately.

A similar argument holds for the "low" values – we would not reasonably expect that variable to fall, or rarely would it fall, below our "low" estimate of it. Once we have completed the task of creating a "high"/"low" range for each of the input variables that we tend to assess, we will end up with a table as shown in the left-hand side of Figure 6.2. To complete the table, we will change the input values, one-at-a-time, to their "high" and "low" values, and record the resulting 10-year NPV value for each change. When finished, we will end up with the completed Figure 6.3. (Note that I am not saying the 10-year NPV(7.7%), as I stressed we should, as the discount rate is one of the variables we are going to change.)

The "V6.1_Tornado_Diagram_Input_Table" video will show how, step-by-step, to create the table in Figure 6.2. While our focus was previously on creating a "dynamic" spreadsheet, it is important to note that Figure 6.2 is a static table – a list of static numbers. There are no formulas or links to the rest of the model we created. This is important as we do not want the values in this table to change as we continue to change other input-variables of the dynamic model we created. Figure 6.2 is strictly a table of numbers that will be utilized to create a tornado diagram for this project. (More details in the "V6.1_Tornado_Diagram_Input_Table" video.)

	Variable		% Change from Base		
	Low	High	NPV (Low)	NPV (High)	Range(%)
Capital (±10%; Base=$4.75 million):	4,275,000	5,225,000	69.03%	130.97%	61.93%
Hurdle Rate above WACC (0% - 2%; Base=1%):	0.0%	2.0%	81.80%	119.62%	37.82%
Projected Revenue Increase (±20% of Base case, Base=20%):	16.0%	24.0%	18.07%	181.93%	163.87%
COGS Margin: (±10% of Base; Base = 79.1%):	71.2%	87.0%	-95.21%	295.21%	390.41%
SG&A Margin: (±10% of Base case; Base = 4.3%):	3.9%	4.7%	89.39%	110.61%	21.22%
Years to max Revenue: (4 to 7 years; base=5):	4	7	39.64%	132.41%	92.77%
Maintenance: (±10% of Base case; Base = 5% of Cap.):	4.5%	5.5%	92.14%	107.86%	15.72%

Figure 6.2. Table of Variables Assessed for the Example Project and their Impact on the Project's 10-year NPV

We certainly do not want to hand this table to our CFO. Most managers would simply roll their eyes back into their heads if they saw it – an overwhelming number of numbers! Instead, we will use this table to create an easy-to-understand and digestible tornado diagram. But the first thing we need to do is determine the input variables ranges over which we will assess the project's NPV.

Input Variable Ranges

When creating an input table for a tornado diagram, we need to think about all the variables in our model and what values – beyond the base case – form a reasonable range for these variables. What has been our historic range for COGS Margin, for example? Did the engineering group determine a range for the capital estimate or simply a single value? What do they think it is a reasonable range? Have we done capital projects like the one proposed in the past? How did the actual capital expenditures in those historic projects compare with their initial estimates? Developing reasonable ranges for each input variable is where we lean on the third "R" in the QMCR^3 model—Relative comparisons. Is there context – background or history—that will help guide our selection of the appropriate ranges for each input variable? If there are, we should document the source of that context for inclusion in our report that we will write at the conclusion of our analysis.

In this specific project example, we are not provided with much, if any, context from which to base realistic variable ranges. We will proceed with this example as best we can by utilizing the information we do have. For example, we do know that the CFO is not too concerned over the capital estimate from the engineering group. This implies that the engineering group has a reputation for being accurate. We'll put this variable into our sensitivity analysis, but we'll keep the range rather tight, making it plus or minus 10% of the original estimate. Varying the hurdle rate is not likely to have much impact on the result (unless we make extreme changes to it), but there are managers that always ask so we will put this in our study. For this variable, we will vary the additional hurdle rate from 0% to 2% above the firm's WACC (the base-case was 1%).

The CFO is concerned about the impact of the revenue increase estimates from the marketing group. That suggests that the historic estimates from this group have not been as accurate as that from the engineering group. We'll therefore put a wider range on this variable ±20% of the base-case value for the revenue increase of 20% of the current company's total revenue value. In other words, we'll examine the impact of the revenue increase for a range from 16% (0.8*20%) to 24% (1.2*20%) of the current corporate revenue value. The other variable that impacts the revenue number is the years to reach this maximum revenue increase value. The base case was 5-years. It is not likely to be much less than that, but may be much more so we will look at a range of this variable from 4 years (minimum) to 7 years (maximum). (Note that these input ranges do not need to be, and often are not, symmetric.)

The maintenance margin will not likely vary much as this value is based on the company's history of operating production facilities. We'll include this variable in the study as someone may ask, but examine it over a narrow range of ±10% of its original estimate. If the project was for a product that the company had no experience creating or one which was mechanically more complicated than the firm's present product, we might consider a maintenance percentage higher than the company's historic average. But in this example, we are expanding the production of an existing product, so the maintenance should be close to the firm's historic average which was our base-case of 5% of the project's capital investment.

The SG&A and COGS margins could both vary with the expansion. Each may also extend beyond the firm's historic averages, so be careful not fall into that trap. Our existing sales people may be able to sell more product to existing customers which would drop the SG&A margins. On the other hand, we may need to hire more sales people if we are expanding our sales across the globe, so it is feasible that the numbers could also go up. Either way, the SG&A margins shouldn't change too much, so we'll start our examination the range of ±10% of the original 4.3% estimate. COGS Margins could also go up or down with the expansion. Purchasing our raw materials in larger volumes may avail us to large-volume discounts. On the other hand, if the raw materials we need are in short-supply globally, buying more could prove to be both difficult and expensive. Labor could similarly go either way. We may be able to produce more with the same labor force (once our new machinery is in place) which would lower the labor portion of our COGS margins, or we may have to add additional shifts (and pay our employees shift-differentials for those shifts) which could drive up our labor cost per revenue. Changes in the raw materials and labor components of the COGS Margin could also balance each other out or amplify each other, making it difficult to predict what a reasonable range should be without some more company context. For this example, we'll start the analysis with ±10% range around the original COGS margin and then make changes from there if warranted.

In total, we are assessing the impact on the project's NPV that changes to seven different variables may cause. The first three columns of Figure 6.2 describe each variable (including the range and the base-case value), and the "Low" and "High" values assessed for each variable of our analysis. Again, Figure 6.2 is not a dynamic spreadsheet, it is simply a table of values.

Variable Impact on 10-year NPV

Once we have the "high" and "low" values determined for each of the seven variables, we need to calculate the 10-year NPV for each change. (Notice that I am not including the discount rate as part of that NPV description as that is one of the variables that we are changing.) Please note that we are not inserting a $-figure NPV values into our table. We are tracking the relative change from the base-case NPV ("new NPV" divided by the base-case NPV value). Percent changes are easier to grasp and we want this graphic to be easily digestible. My brother, who has a bird for a pet, told me that his bird was 20 grams overweight. Twenty grams isn't very much, so how big a problem could this be? Then he said that the bird should weigh 100 grams so it is 20% over its ideal weight. OK, that's a lot overweight. Relative values are easy to digest without having to provide the extra context. Since we are trying to present the data in as clear and concise way as possible and given that we are seeking insight into the relative impact these variable changes have on the NPV, it is only the relative output (relative to the base-case NPV) that we will be tracking.

Given that we are examining the high and low values for seven different input-variables, we will be calculating 14 relative NPV values. To do this we need to change the input value, one at a time, for each of the input-variables of our study and then put the resulting relative 10-year NPV value in our output table. (The "relative" NPV value is the newly calculate 10-year NPV value divided by the base-case NPV value.) Fortunately, we created a dynamic NPV model for this project, which makes this doable without much difficulty. This would be very difficult work, if not impossible to do, without first creating the dynamic financial model that we build. This is why we spent the extra time up-front imbedding that amount of flexibility in our project NPV calculation spreadsheet. Making 14 input value changes (one-at-a time) and recording the result (relative 10-year NPV value) is a bit tedious, perhaps, but not difficult utilizing the dynamic model we created in the previous chapter.

There are two issues needs to be careful of when completing the table represented in Figure 6.2. The first is that That is, is that we are recording the "high" and "low" NPV value related to the end-points of the range of input values. Since the NPV can increase when a variable decreases, the "high" NPV value (or high output value in general) will not always be associated with the "high" input value. For example, the low Capital value over the range assessed range will produce the high NPV value. The opposite is true for COGS margins. A "high" COGS margin value will result in the "low" NPV value for that variable's range. Some attention must therefore be paid when choosing the proper columns to insert the resulting NPV value from changes in the input values. Getting the data in the right columns is important to creating the tornado diagram graphic.

The second issue that arises in the completion of the output table is to remember to "reset" the spreadsheet back to the base-case value before changing the next sequential variable. For example, if we are changing the CapEx input value, we will put in the "low value" of that range, record that output, then insert the "high value" for that CapEx value and record that output value. Before moving on to changes in the next variable, we need to re-set the CapEx input variable back to its base-case value. Forgetting to do so will cause us to evaluate the impact of variable combinations and not of single-variable changes. It is easy to forget when you are doing 14 changes, so you must train yourself to avoid this mistake.

The final column in Figure 6.2 is the magnitude of the change in NPV from the low to the high value. This is a calculated value. The range or “change” or “delta” is the difference between the High and Low NPV values for that row (High_NPV – Low_NPV). We will be sorting the table on these values so that our tornado diagram will have the high-impact variable changes at the top (and look properly like a “funnel” when we are done). If the “high” and “low” NPV changes were accidently placed in the wrong columns, then this “difference” value will be negative (which makes it a good check). The “V6.1_Tornado_Diagram_Input_Table” video will provide the details on how to create the table in Figure 6.2.

Tornado Diagram Graphic

The tornado diagram is a visual representation of the project’s risks. If we have picked the ranges of each variable correctly (not likely to be higher than the “high” value, not likely to be lower than the “low” value) then the result will be insightful. (Always remember that the first rule of modeling always applies: “Garbage in = Garbage out.”) Granted in this example, we didn’t have a great deal of information and we picked the variable ranges rather imprecisely. It is better to start that way than get too bogged down in figuring the ranges of a variable that ends up having no to little impact on the final outcome. The ranges can always be adjusted as we learn more, so start somewhere and then adjust as necessary.

Figure 6.3 shows the tornado diagram for this project, based on the ranges of the seven variables assessed. A tornado diagram does not show the interaction of the input variables, just the result of changing them one at a time. To understand the impact of the variable’s interaction (as in a combination of the time to maximum revenue generated and the % Projected Revenue Increase) would take a full statistical project analysis using “Crystal Ball” or some equivalent tool. However, the tornado diagram, which can be simply built in Excel utilizing the provided template (see “V6.2_Tornado_Diagram_Graphic_Creation” video and associated spreadsheets for details), provides a great deal of insight into the project and its risks.

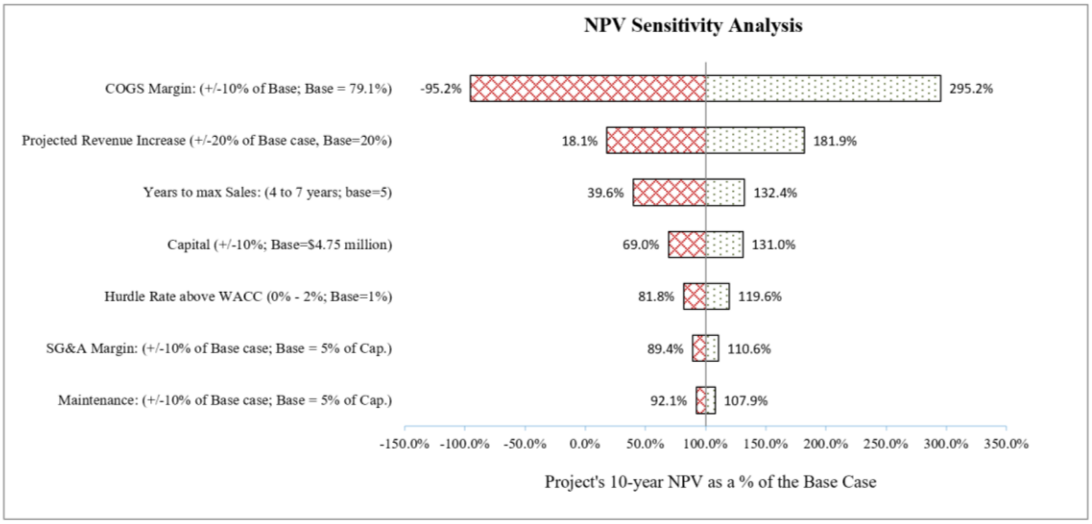

Figure 6.3. Tornado Diagram for Example Project's 10-Year NPV

The analysis visualized in Figure 6.3, confirmed the CFO's "gut feel" that the "revenue increase" estimate is a potential concern. Changes from our 20% of the firm's current revenue base-case yielded the second-highest impact on the project's 10-year NPV. The "Years to maximum sales" value (5 years in the base case), also jumps out in the tornado diagram as something that should be further investigated. The variability in the impact on the capital estimate, was less significant (again, as the CFO predicted) and the variability of remaining assessed elements, that fall below Capital on the chart (Hurdle Rate, SG&A Margin, Maintenance), have little financial impact on the project.

Surprisingly, the variable with the highest impact was the COGS Margin. It was likely that no one in the firm was thinking about this factor at all. Afterall, the company is currently producing this product and has a solid history of the COGS Margin value. However, as we mentioned in the input table creation, the COGS Margin could change significantly with the expansion. This is insight gained from the analysis that might have been completely missed by everyone's "gut feel." The purchasing group now needs to be solicited for input. They need to do some research into the impact of the potential plant expansion has on the purchase price of the necessary raw materials. The plant's operating management also needs to be involved in providing post-expansion labor estimates. Neither group was likely even talked to up until this point… the focus being on the capital requirement and increases in revenue. But it is now clear that input from these two groups is important in determining the success or failure of this project. That's the power of performing the financial analysis. That's how you, as a financial analyst, can have a huge impact on your firm and its direction despite you not sitting in the "C-suite." Being a corporate "soothsayer" is a very influential role.

<u>Deeper Dive</u>

The tornado diagram has provided insight into what elements of the project drive its financial success. Two of those elements are related to the revenue that the expansion is expected to deliver (the magnitude of that revenue gain) and the pace at which the firm can achieve that revenue gain. The other item is related to the impact the expansion may have on its manufacturing cost, especially its cost of goods sold (materials and direct labor costs).

The CFO had initially asked us to provide the minimum revenue increase (expressed as a percentage of the company's current total revenue) that the project could deliver and still not lose money. In finance terms, that is a project NPV of zero. When the present value of a future project is zero, that is equivalent to having done nothing from a financial perspective. We spent money, we increased our activities, but in the end it was a financial wash. No value gained for the firm, but none lost either. Such analysis establishes a success "boundary condition" beyond which the project becomes financially non-viable. It is very important to establish "the conditions under which the project can be financially viable."

Now that we have identified the three variables that we know are quite influential in determining the financial success of the project, we should find the value of each of those items that creates a nil value for the project's 10-year net present value (discounted at 7.7%). The "how" to do this in Excel is detailed in the "V6.3_Project_Success_Conditions" video. It is an easy task utilizing Excel's "Goal Seek" function.

For this example, the project's 10-year NPV (7.7%) is equal to zero when any one of the following is true:

- COGS Margin = 83.2% of revenue (79.1% was the base-case assumption)
- Projected Revenue Increase = 15.1% of current company revenue (20% was the base-case assumption)
- Time to Maximum Revenue Gained = 8.4 years (this was 5 years in the base case)

We can now drill a bit deeper and plot precisely how the project's 10-year NPV(7.7%) would drop as each of these variables increases (or decreases in terms of the "revenue increase" value). The details of the creation of those plots are also covered in the "V6.3_Project_Success_Conditions" video. The results of those calculations are illustrated in Figures 6.4, 6.5 and 6.6 below. Again, it is better to present graphics versus tables of numbers when presenting to management so as not to overwhelm them with "numbers."

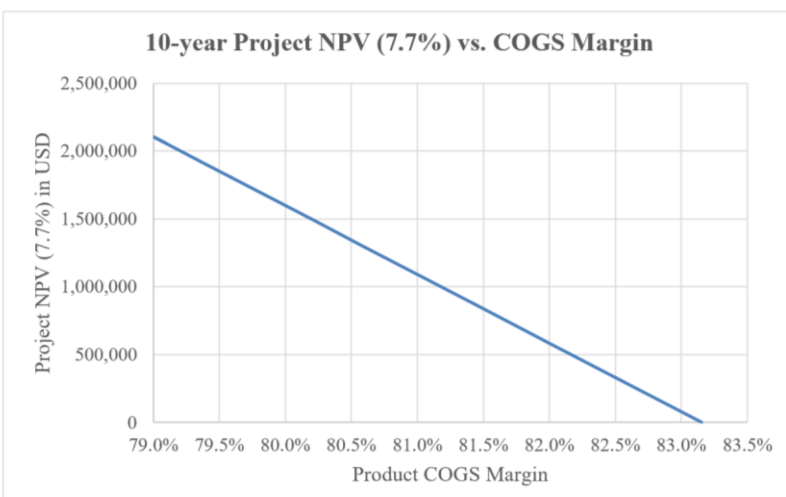

Figure 6.4. Decrease in Project's 10-year NPV (7.7%) with increasing COGS Margin

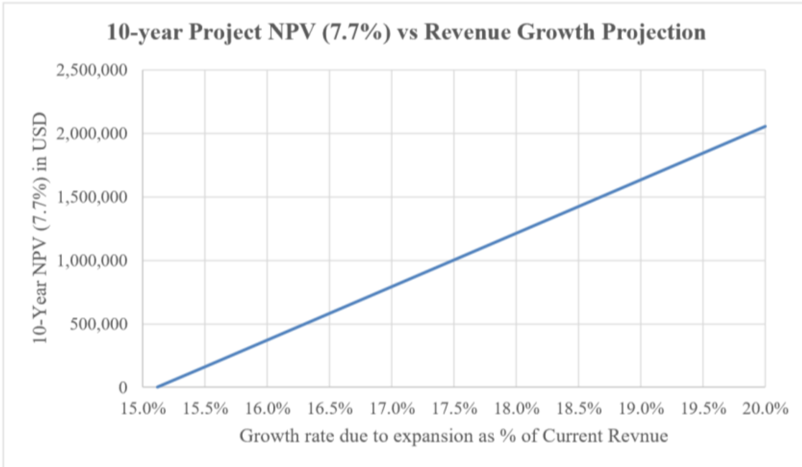

Figure 6.5. Decrease in Project's 10-year NPV (7.7%) with decreasing Revenue Potential

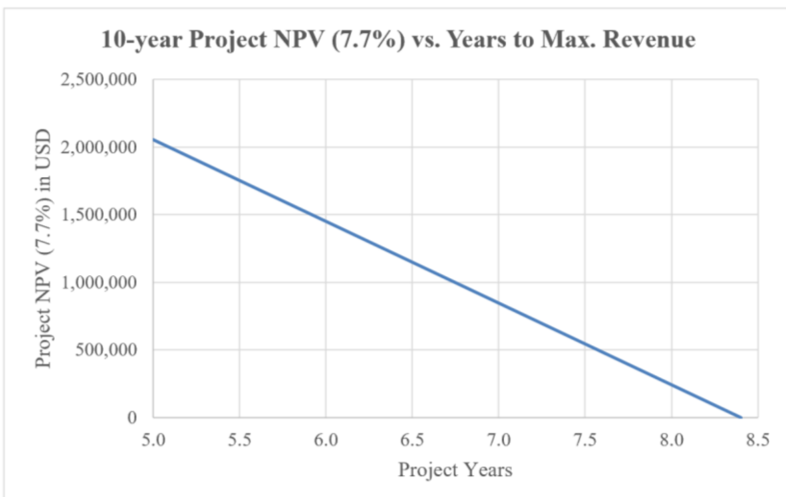

Figure 6.6. Decrease in Project's 10-year NPV (7.7%) with increasing Years to Maximum Revenue Realization

Chapter Summary

In this chapter, we completed the analysis of our example project. We created reasonable ranges (values unlikely to be higher than the high or lower than the low) for each input-variable examined. The consequences to changing the input value (the output changes) were measured as a fraction (or %) of the base-case 10-year NPV(7.7%). We created a table that recorded the one-at-a-time input/output combinations. We then utilized this output table as a tornado diagram input table. That tornado diagram visually and dramatically visually communicates the results of this sensitivity analysis.

The tornado diagram made it easy to clearly identify the top three project risks: COGS Margin, Revenue Increase, and time to revenue increase. Success boundary conditions (variable values which would generate an NPV of zero) were determined for each of these variables. Graphics were then created illustrating the sensitivity of the project's 10-year NPV(7.7%) with changes in each of these input variables. The three videos, listed below, show the step-by-step procedures for completing this work:

V6.1_Tornado_Diagram_Input_Table
V6.2_Tornado_Diagram_Graphic_Creation
V6.3_Project_Success_Conditions.

We approached this hypothetical project by utilizing the $QMCR^3$ mnemonic. We know we have now completed this project's analysis as we have completed every element of that mnemonic. We understand the **Q**uestion, have determined the appropriate **M**easure, performed the **C**alculations and are prepared to make a **R**ecommendation based on the projects **R**isks that were uncovered by the analysis and supported by the firm's **R**elevant context. (Each element of this mnemonic is detailed in the next chapter.) We are now ready to write a report which summarizes our findings. That report-writing will be fully described in Chapter 7 by writing an example report for the hypothetical project we have been assessing.

CHAPTER 7: PROJECT FINANCIAL REPORT

There is a popular quote (attributed to Robin Sharma) that is based on an ancient Chinese proverb that says, “knowing and not doing is the same as not knowing” (Sharma, n.d.). This is a condensed way to say that, from the perspective of an outside observer, one cannot tell if the person facing an issue does not know what to do or simply isn’t doing what they know needs to be done.

There is a similar argument to be made regarding communication. Ideally, the insights acquired by performing financial analyses, through considerable effort on the part of the analyst, will allow decision-makers to make better decisions. If, however, those insights are not well-communicated, at least not communicated in a manner in which decision-makers can digest and utilize them, then it is the same as if those insights never existed in the first place.

Think about it this way. You know something vitally important to your best friend. That information will change their lives. You have toiled hard to gain the understanding your friend now needs to have. If you communicated this information to your friend in a language they do not understand, say an ancient Sumerian language, would that be at all helpful to them? Obviously not. Although the information could be life-changing, it has no impact on your friend if they cannot comprehend what you are talking about. Communicating financial insights is no different. As a result, the work of the analyst is not done until the communication takes place.

All of this is to say that it would be simply shameful to waste the efforts and insights gained from the financial analysis by not communicating those insights in a manner in which they can be understood and acted upon. Which means we need to communicate those findings in as simple a way possible. As Albert Einstein said (Einstein, n.d.), “Make things a simple as possible, but no simpler.” In the end, we are not trying to dazzle our bosses with our brilliance, but help them make better decisions.

We do not have the ability to control what choices decision-makers will ultimately make. But we must provide them with the best information we can in a way that will help them improve their decision-making. That means we need less thinking about what we want to tell them, and more thinking about what they need to understand to make better management decisions.

QMCR^3

This chapter will produce an example report for the hypothetical project example we have been investigating in the last two chapters. Before we start, let’s summarize what we now know about this project, in terms of the framework that we used to approach the problem. In the introduction of this book, it was argued that complete financial analysis would address all elements of the QMCR^3 mnemonic. Let’s put what we now know about this project into this framework.

- **Q**: What question are we trying to answer?
  - In the example we have been discussing, the question appears to be fairly straight-forward: do we move forward with this expansion plan or not? But it is really more than

that. We want to know *under what conditions* this project make financial sense. The sensitivity analysis that we have now completed, including the determining the variable-values that generate a project-value (NPV) of zero, allowed us to address the more detailed question. At this point, not only do we fully understand the question, we also have its answer.

- **M**: is for measure. What will we measure to gain the insights required to answer the question?
  - For this case it is the project's 10-year NPV discounted at the company's hurdle rate. We are also looking to measure how the base-case value we calculated varies with changing assumptions regarding the operation of the project.

- **C**: Calculate. We built a dynamic spreadsheet (i.e. a financial model) that allowed us to calculate the 10-year NPV at the company's hurdle rate for a number of project variables. We then extended the analysis by calculating the variability of the project's base-case NPV over a range of input values (i.e. a range of expected project operating conditions). This is our key to peering into the future. We did not simply determine the base-case NPV, but created a financial model that allowed us to determine what the financial outcome will be "what-if" we do this or "what-if" we do that… before we actually do any of those things. That's pretty powerful.

- **R^3**
  - **R**: Recommendation? (Explain all this in ENGLISH) We can now ready to make a recommendation because we know not only the base-case value of the project's NPV, but under what conditions the project remains financially viable. The financial analyst is typically not the decision-maker. That decision-maker likely has a broader purview than that of the analyst and, as a result, may ultimately make a decision contrary to the analyst's recommendation. That happens. The analyst's job is to provide the best counsel possible.

    In this case our recommendation is to acquire better data before the company makes a "go" / "no go" decision on this project. Three specific input-variables (COGS Margin, Revenue Increase, and Rate of Revenue Increase) are critical to the project's success and the recommendation is that we should be confident in their estimates before proceeding.

    When asked to forecast a company's margins, the "quick-and-dirty" answer is to base that forecast on their historical values. Most of the time that's fine and was likely what was done for this project. However, now we know that the project's financial viability hinges on the COGS margin, As a result, we need to make sure we have a solid estimate for its future value. Better still, we ideally would like estimates for a range of values we could reasonably expect the COGS margin to be going forward. Similar story for the revenue increase and timing. The sales group was probably asked to do a forecast. They did one. Maybe it was a thorough study, but maybe not. Now we know that the revenue forecast is a very important number to the financial success of this project. As a result, that group needs to ensure they produced a rock-solid projection. Following up with more specific requests is good management, but your boss won't know to ask those questions unless your analysis tells them it is important.

- **R**: What are the risks? Any recommendation must include risks and context (relative comparisons), the second and third of the "R's." The sensitivity analysis provides insight into the risks. We know that the success of the project hinges on the amount of additional revenue that the project can produce for the firm, the time to achieve this additional revenue, and the impact this project will have on the COGS Margin of the product we will be producing.

- **R**: Relative Context or comparisons, if any. While there was not an abundance of context here, we do know that the CFO was more comfortable with the engineer's estimate for the expansion's costs than she was with the sales/marketing group's estimate of future revenue that the project could generate.

  Given that the revenue magnitude and growth rate both represent significant financial risks to the success of the project, is evidence that more work needs to be done defining these before a "go" / "no go" project decision can be made.

  The final insight the analysis revealed overcame a "blindness" that the firm likely had due to its background and history producing the product. Because it is currently producing this product, everyone felt they "knew" the COGS Margin. That fact that it could change – and that the change could have a significant impact on the project's success – only came to light because of this analysis. This is a cautionary tale with an important lesson. Often it is the things we simply *think* we "know" -- and therefore never question the fact that we are indeed making an assumption—are the things that bite us on the backside in the end. Stay alert and avoid getting lulled to sleep by things we only "think" we know.

Knowing that we have completed every aspect of the $QMCR^3$ mnemonic should give us confident that we are ready to write the report. The remainder of this chapter will focus on the creation of that document.

The Report

The art of writing a financial report is not to overwhelm people with numbers. The numbers justify your recommendations, they support your conclusions, but your conclusions and recommendations are the center stage act, not the numbers. It is a tricky balance in presenting enough numbers to support your conclusion without overwhelming the reader with too many numbers. Art takes practice.

Be aware of too much detail. We want to provide enough detail so that our reader has confident the recommendation is based on sound analyses and not simply our opinion. However, we need to be wary of being too specific, especially when reporting the numbers. Establishing and maintaining credibility is key. Try to avoid things that will cause the reader to question your or the report's credibility. Yes, we calculated a base-case 10-year NPV(7.7%) but do not say that it is $2,055,549.49. It is silly to think anyone can predict 10 years into the future to the penny. The report should enhance the writer's credibility by supporting their conclusions/recommendations with evidence. Reporting numbers like that reduces the report-writer's credibility. It's $2 million NPV value or maybe a $2.056 million value, but do not report it to the penny. Think about what the value means to the reader: this value only states that if we do this project, it has a projected value TODAY of ~$2 million over not doing it at all. If I tell you that if you reach into your left pocket you will have nothing, but reach into your right pocket and you'll pull "about" $2 million, which pocket will you reach into? You don't need to know that number to the penny to make that decision.

Many people abhor numbers, even many high-ranking organizational leaders. When a barrage of numbers start flying at them, their eyes glaze over and their brains freeze up. But they still need the insight you have acquired, so you need to present it in a meaningful way (to them). A report with no substance to support its recommendations/conclusions is nothing more than an opinion piece and everyone has an opinion. At the other extreme, a report that is so heavy in substantive details (including a dizzying amount of numbers) or that is incomprehensible to anyone, short of an expert in corporate finance, is also worthless to decision-makers as they will simply ignore it. You therefore need to develop TWO skillsets to provide insightful insights from financial analysis: (1) the ability to perform the financial analysis and (2) the ability to report that information in a way that is meaningful and comprehensible to the decision-makers. These are two very different skills, but both are equally important.

It is, after all, not our place to make a decision about this project. The decision-maker's role is to do that. Our job is to make sure the decision-maker has the information required to make a sound decision. That's powerful influence on the future workings of our firm. But to make that happen, we need to write a report that is clear, concise, direct, fact-based and actionable.

<u>Audience</u>

Reports need to be clear, concise, direct, fact-based and actionable. Every writer must focus on the needs of the audience they are writing for. Writing financial reports is no different. Who is the report for? What will they do with it? Yes, the report will initially go to your direct boss, but it will likely rise higher in the organization, especially if your boss is not the ultimate decision-maker. The information presented in the report has to be accessible to the reader. Meaning straight-forward communication that is easily digestible by your audience. The primary challenge is that your audience are very likely *not* "numbers people." You therefore need to communicate your findings without overly burdening them on the *how* of your calculations, but by focusing on the impact of the results. The "how you did this" will be in the appendix of the report, so that the work can be replicated by someone else skilled in the art at some future juncture, but that is not the main feature of the report. Sad to say that most of the details of the analysis that we spent so much time doing will be constrained to the report's appendices. Take heart, some analyst in the future will dust off your old report and be completely enthralled by analytical brilliance! In the meantime, you can also take solace in the fact that you have helped determine the direction of the firm, if only for this one project.

<u>Report Document</u>

The QMCR[3] framework provided an approached to attack financial analyses challenges. It is definitely NOT the order a decision-maker wants the information is presented to them. This is a <u>business report</u>. This business report is not a mystery novel, but one conveying actionable information up-front. Business reports need to be **clear, concise, direct, fact-based and actionable.** The details of the analysis that support your actionable recommendations belong in the report's appendix, not in the main body. There needs to be enough data in the report, however, to make it "fact-based." Graphics are much better than tables in presenting fact-based results. The order of the major sections of the report (while not absolute) is nearly the reverse of the path we took to obtain the insight we now need to communicate. While report structures can vary from company to company, the report to decision-makers should look more or less like this:

Report Outline

1. Background
   Remind the reader what the company issue is (be sensitive to the fact that they are juggling many balls). Put in important-to-know background here, but be BRIEF. You can explain details later in the report, but here you are just reminding the reader of the issues and its context.

2. What's the recommendation?
   What action are you proposing? You are not writing a mystery novel that will "reveal" the recommendation at the end, put it up-front! The remainder of the report will support this recommendation, but say it first, then justify your position. This is the opposite of how you arrived at this conclusion, of course, but the report is not a chronology of your analysis.

3. Analysis Overview
   a. What's the recommendation based upon?
      What did you **M**easure? How does it compare to alternatives? (Don't forget that "doing nothing" is an alternative.) What significant assumptions were made in this analysis? Don't get bogged down in all the details of your calculations here, but do point out the important underlying assumptions made in your analysis (particularly if they relate to the risks you uncovered.)

   b. What are the key risks that could subvert the success of this project?
      All projects have risks and unknowns. Some are critical to the project's economic viability and others are less so. Good managers focus on the significant issues and don't get bogged down by the trivial ones. But they first have to know which is which. Again, a good financial analysis can greatly improve on "gut feel." To manage the project's risks, we first need to know "HOW" it is risky. What elements of the project most significantly determine the project's financial success? Identify the risks and part of your recommendation should be aimed at how to mitigate those risks.

   Appendixes
   a. This is where you put the details of the "how" you achieved this insight.
      Details of how you performed your analysis will be in the appendix and not included in the body of the report. The body should include the approach you took, but the details of how you calculated those values are saved for the appendixes. Even still, the "how" that is included in the report appendices is **not** the minute details of the calculations… not an explanation of "cell B6 times C34" or even "used Excel's 'goal-seek' function to…." No. the "how" is greater detail of the *approach* you took to that lead to the insight. You calculated a 10-year NPV at the company hurdle rate, etc. You performed a sensitivity analysis across seven different input-variables. What did you assume for upper and lower

limits for each of these variables? How were these boundary conditions determined? Remember, you want to present enough information in the body of the report to allow the decision-makers to make a data-based decision. The details of what you did will be in the appendix of a final report in case someone else has to go back and revisit and/or update this analysis in the future. (It is good to keep in mind that that you may be that future analyst, so do your future self a favor by providing enough detail in the appendices that would allow you to re-do the calculations a year or more from the time you did them originally.) The "final" project report can also include screen-shots of the excel models in the appendices.

Report Length

Lastly, an "initial" project report is usually relatively short (1-2 pages; <1000 words), with any necessary supporting documentation as appendices. The report still has to be substantive, however, as the writer has to assume that the reader will never look at the appendices. One therefore cannot say, "I think we should go ahead with this project (see appendices for details)." That is simply an opinion. Be **clear, concise, direct, fact-based and actionable**. Put enough details in the report to make it "fact-based," without overwhelming the reader. Its an art to be sure. You will undoubtedly have to write every report at least twice: the first draft to lay out your argument and conclusion and the second version to put the information in the proper order and make it concise. Writing a short document is more difficult than writing a long one. Write the long one first, as your first draft, then edit it into a form and length that the decision-makers will appreciate.

The remainder of this chapter will be a specific example report based on the analysis of the fictitious project that was assessed in Chapters 5 and 6. This report will be written to the firm's CFO who assigned us the project to assess. However, our audience is beyond the CFO and will likely include anyone involved in making a decision as to the future of this expansion project. We will not be writing the report in financial jargon that only the CFO would be familiar, but in a language that the CEO and her support staff would be able to grasp and take action upon. The report will be written as an "initial" report, but will include more details in the appendices than an initial report would usually contain so as to demonstrate how to organize detailed information into appendices. Often times, initial project reports do not include any appendices (just the base <1000-word document); again, this varies from firm to firm.

Before we start: A Reminder of where this all started

Remember that when the CFO assigned us to "run some numbers" on this expansion project that she had some concerns. Specifically, the CFO wanted you to run two scenarios. The "base case" where everything goes according to the forecasts of the engineering and marketing groups. The CFO feels pretty good about the capital estimates for the project coming from the engineering group. She is less confident on the sales growth numbers from the marketing department. Marketing is anticipating that the company's revenue will increase 20% (over five years) as a result of this project, but the CFO is asking you to determine the overall sales increase that would generate an NPV of zero. That is one of the "boundaries conditions" that would make the project financially viable as it represents the lowest acceptable sales increase for which the project would be financially viable. Any growth less than that value and the company would lose money on this expansion.

We need to think about this beginning before we start for a couple of reasons. One is that since that time we have we have been engrossed in this project and its details. But the CFO's thinking has not undergone such an evolution. That means we cannot jump right into to what we now know, but instead need to start from where the CFO left us. Any insights we gained via our immersion in this project has to be put into a context of new understanding or as "new" or "unanticipated" results (from the CFO's perspective). That means we must start this report with where the CFO was mentally at when she assigned it to us, not where we are at in our thinking about the project now. To move people along, you have to start where they are. Providing someone driving directions for someone who is lost starting from somewhere other than their current physical location would be absurd. Don't do the equivalent by starting your report somewhere other than the audience's current state of mind.

An example of a report is given at the end of this chapter. It is not the only way to write one, and is not presented as the "perfect" report. It is however, better to see one example than talk all day about the theory about what a report should be. Some summary comments will be made before the report is presented, but you may want to wait and read those comments after you read the report.

Final Report Thoughts

Company culture partly dictates how much information is presented before the recommendation section of your report. It could be argued that this report is overly detailed for an "initial" report. Indeed, an initial report could have been completely satisfactory without any of the appendices. They were included as an illustration of how and where to insert detailed analyses. As it is, the body of the report is less than 650 words and the critical portion – background and recommendations – make up only 318 of those words. That means, a decision-maker would only have to read 318 words to understand the project and decide what to do next. The rest of the seven-page report (assuming all the Appendices began on a new page, which should be the case), substantiates the analyst's credibility and provides readers with detailed information (i.e., what was done). Company projects can go idle for long periods of time and then be suddenly resurrected. If you must perform additional analysis of this project in a year, you will be glad you included all the details you inserted into the appendices!

The financial analysis reports can always be made longer, and more thorough, by adding copies of the dynamic financial models to an appendix. These additional appendices could detail how the financial models were built and utilized. In some firms, it is common to only summarize the "Analysis Overview" section in a paragraph or two and move the remaining details that are in this report to an appendix. However the report is structured, the focus should be on communicating what needs to be communicated in order to help the reader reach a conclusion. All "supporting" materials should be presented in a way that makes them available (even if only to corporate historians or project reviewers) but does not overwhelm the reader. Remember, reports should be: clear, concise, direct, fact-based and actionable.

It is best to error on the side of filing shorter reports, particularly for initial reports. This report, as mentioned before, could go forward without any of the appendixes and be fine for an initial report. It was written as it was to demonstrate how to integrate all of the findings. Most reports don't need **all** the findings reported, although the analyst is temped to put them in. Just include enough supporting details to support the recommendations.

There are several reasons for erroring on the side of shorter reports (even though that is counter-intuitive to the author). First, you will want to get this initial report out quickly, so that the decision-makers know there is more work to be done before they start thinking about breaking ground on a plant expansion. Longer reports simply take more time to write, time which you may not have initially. Secondly, there will usually be opportunities to write follow-on reports on the project—perhaps a second report after the input variable ranges are better defined, then maybe a 'final' report right before or sometimes even after, the final project decision has been made. You'll have more time for detailed report-writing at that time. What you NEVER want to do is to cause a significant delay in the decision-making process because the decision-makers are waiting for a report from you! Give them what they need to take the next step and save the details for capturing the complete analysis history after the project is either launched or killed.

Sample Report

*****

To: CFO
From: You
Date: April 30, 2022
RE: Production Expansion Proposal Financial Analysis

Background
Our specialty chemical firm currently has annual revenues of $50 million. Given that we are selling everything we can produce, increasing revenue is dependent on expanding production capability. This is an initial financial analysis of a proposed plant expansion of our existing product production plant. The capital investment for this project is estimated, by our engineering group, to be $4.75 million. The sales and marketing group has estimated that sale of the increased volume of product that this expansion will allow us to produce would increase the firm's overall revenue by 20% over five years, or $2 million increase in revenue each year for five years. At the end of the five-year period, the sales/marketing team has concluded that we would, once again, be selling all the product that we could produce and our revenue would, again flatten out at $60 million.

Conclusion and Recommendation
The base-case assumed that the project would increase our revenue by 20% and that this increase would occur over five years. The base-case analysis also assumed that our current COGS Margin (79.1% of sales) would be unaffected by the increase in production and sales. The base-case analysis of the project was positive, ~$2million 10-Year NPV(7.7%) with an IRR of 14%, and would suggest that this project move forward. However, further sensitivity analysis indicated that the financial variably of this project was substantially dependent on the three aforementioned input variables.

Given the insight produced by this analysis, the following is recommended before any “go”/”no go” project decision is made.

(1) Consult with purchasing and manufacturing to better understand the impact the production increase would have on our labor and raw material costs.
(2) Have sales/marketing further assess the revenue increase and its timing. That assessment should include reasonable ranges for both the total revenue increase expected and the timing of that revenue gain.
(3) Re-run the sensitivity analysis with this improved input data.

<u>Analysis Overview</u>

As is standard practice in our firm, projects of this nature are assessed by determining the project’s Net Present Value (the present value of their future benefit). A 10-year NPV, discounted at the company’s hurdle rate (7.7%) was calculated for this project. The base-case NPV for this project is $2.06 million with an IRR (internal rate of return) for this base-case scenario of 14.4%. The project’s Cumulative Discounted Cash Flow (DCF) indicates that the project would break-even – assuming the base-case assumptions hold – in year 7 (see Appendix A for detailed project cumulative discounted cash-flow analysis plot).

The project sensitivity tornado diagram, Figure 1, reveals that variations in any one of three elements of this project from their base-case assumed values can significantly change the project’s financial viability. (Appendix B contains the detailed results for the seven-variable analysis that was performed.) Two of those three driving elements are related to future revenue this project will produce: the amount and timing of the revenue increase that the production capacity increase will make possible. The unexpected third element, which the analysis illuminated as having the single greatest impact on the project’s financial success, is the impact that significantly expanding product production may have on the product’s cost-of-goods sold (COGS) margin.

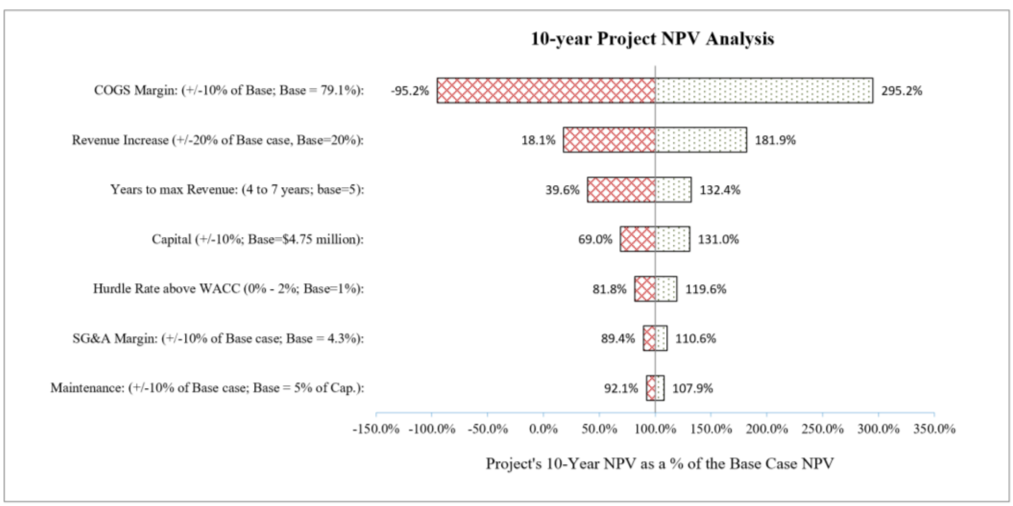

Figure 1. Project Tornado Diagram of Input Variables on Project 10-year NPV

The project would only break even (10-year NPV(7.7%)=0) if any one of the following occurred:

COGS Margin: increased to 83.1% (the base-case value was 79.1%)

Revenue increase (% increase over current revenue): drops to 15.1% (base-case of 20%)
Years to attain that revenue increase: increased to 8.4 years (base-case of 5 years)

Appendix C contains graphics that display how incremental changes in these parameters would impact the project's 10-year NPV (7.7%).

Given that the financial viability of this project is tightly linked to variability of these three project elements, it is recommended that the firm be confident that our forecasted values for each are as accurate as feasible before deciding on the fate of this project. Hence the recommendations made in the prior section of this report.

Appendix A: Project's Base-Case Discounted Cash Flow Analysis

A 10-year net present value (NPV) was calculated for this project. Annual cash flow projections were made for 10 years and then these annual cash flows were discounted by the company's hurdle rate of 7.7% or 1% higher than the company's WACC of 6.7%. Standard company project analysis was performed and a project 10-year NPV(7.7%) was determined to be equal to approximately $2.06 million. With the base-case capital investment value of $4.75 million, this represents an internal rate of return for this project of 14.4% (discount rate at which the base-case 10-year NPV=0).

The cumulative discounted cash flow (DCF) for this project is plotted in Figure A1, below. That figure illustrates that the project will break-even in year 7 of this project, assuming all the base-case assumptions hold true.

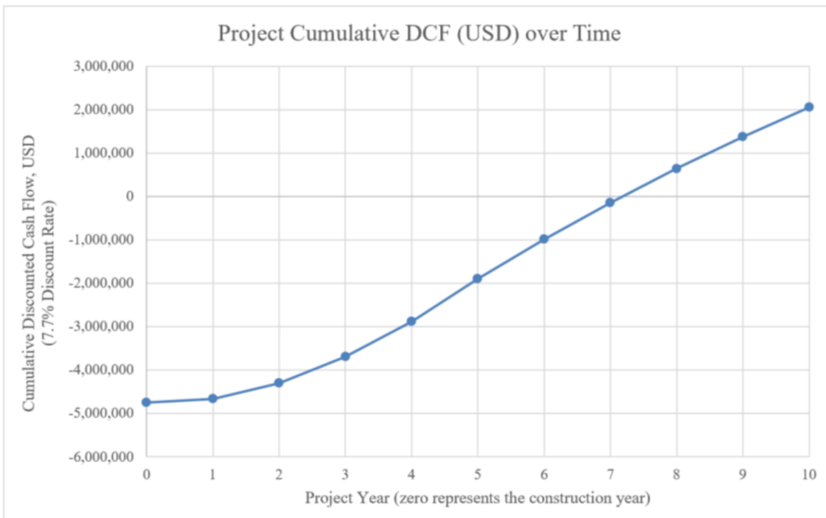

Figure A1. Project Cumulative Discounted Cash Flow (DCF) over time

Appendix B: Tornado Diagram Details

The sensitivity of the project's 10-year NPV to changes in the model input values from the base-case values was assessed by first determining reasonable high and low range limits to each of the seven input variables assessed. The list of those seven variables and their respective high/low, base-case values used for each is shown in the table of Figure B1.

	Variable	
	Low	High
Capital (±10%; Base=$4.75 million):	4,275,000	5,225,000
Hurdle Rate above WACC (0% - 2%; Base=1%):	0.0%	2.0%
Growth Rate (±20% of Base case, Base=20%):	16.0%	24.0%
COGS Margin: (±10% of Base; Base = 79.3%):	71.2%	87.0%
SG&A Margin: (+10% of Base case; Base = 5% of Cap.):	3.9%	4.7%
Years to max Sales: (4 to 7 years; base=5):	4	7
Maintenance: (±10% of Base case; Base = 5% of Cap.):	4.5%	5.5%

Figure B1. Financial Model Input Variable Ranges

Given our company history of delivering capital projects very close to the cost the engineering group estimated n this specific example, this range on this input variable was small plus or minus 10% of the original estimate. The impact on the project NPV of varying the hurdle rate was also considered, but again, for company history reasons, this range was rather small-- vary the additional hurdle rate to 0% to 2% above the firm's WACC (the base-case was 1%).

It is more difficult to project future sales than building costs, so the range of both the revenue increase this project could yield and the years over which this revenue would be attained were more generous. The project's sensitivity assessment used ±20% of the base-case value for the revenue increase. That base-case revenue increase was of 20% of the current company's total revenue value. In other words, we assessed a range of revenue increases from 16% to 24% of the company's current revenue value of $50 million. The second variable that impacts the revenue number is the years to reach this maximum revenue increase value. The base case was 5-years. It is not likely to be much less than that, but may be much more so we will look at a range of this variable from 4 years (minimum) to 7 years (maximum).

Given we have a long history of operating the current facility, maintenance margin estimate should be quite accurate. As a result, we examined this input variable over a narrow range of ±10% of its base-case value of an annual expenditure of 5%original capital investment.

The SG&A and COGS margins could both vary with the expansion, but are not anticipated vary from our current rates. Our existing sales people may be able to sell more product to existing customers which would drop the SG&A margins. On the other hand, we may need to hire more sales people if we are expanding our sales across the globe, so it is feasible that the numbers could also go up. Either way, the SG&A margins shouldn't change too much, so we'll start our examination the range of ±10% of the original 4.3% estimate. COGS Margins could also go up or down with the expansion. Purchasing our raw materials in larger volumes may avail us to large-volume discounts. On the other hand, if the raw materials we need are in short-supply globally, buying more could prove to be expensive. Labor could similarly go either way. We may be able to produce more with the same labor force (once our new machinery is in place) which would lower the labor portion of our COGS margins, or we may have to add additional shifts (and pay our employees shift-differentials for those shifts) which could drive up our labor cost per revenue. Changes in the raw materials and labor components of the COGS Margin could balance each other out or amplify each other, making it difficult to predict what a reasonable range should be without some more company context. Our initial range for the sensitivity analysis was to use a range of ±10% around the original (and current product) COGS margin of 79.1%.

In total, the impact of seven input variables on the project present value of future cash flow were assessed by changing input variables one-at-a-time to their high and/or low values and recording the resulting change in the project's 10-year NPV. The tornado diagram of Figure B2 was the result.

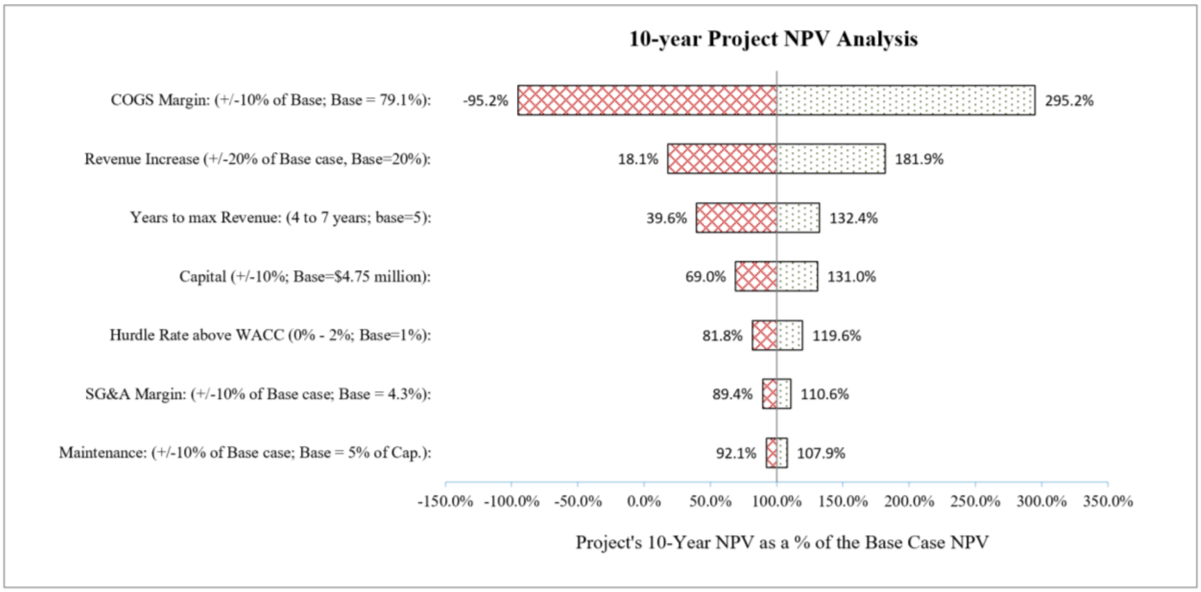

Figure B2. Project Tornado Diagram of Input Variables on Project 10-year NPV

Appendix C: Project NPV Changes with Changes in COGS Margin, Revenue Increase and timing

The project's tornado diagram (see Appendix B for details) revealed that the project's 10-year NPV(7.7%) was most sensitive to changes from the base-case values of three variables: the COGS Margin, the total Revenue Increase and years to achieve that revenue increase. Only changes to these three variables, over the range assessed, resulted in significant changes to the project's 10-year NPV(7.7%). The project goes from being profitable to just breaking even (10-year NPV(7.7%)=0), if any one of these variables changes occurs:

COGS Margin: 83.1% (whereas the base-case value was 79.1%)
Revenue increase (% of current revenue): 15.1% (base-case of 20%)
Years to attain revenue increase: 8.4 years (base-case of 5 years)

In addition, there can expected to be simultaneous changes to both the revenue increase and the years to attain that revenue. These two variables will create a compounding impact on the project's NPV value. For example, if a value of 7 years was utilized for the "years to attain the revenue increase, which was at the top end of the range examined for this variable, then the break-even revenue increase becomes only 17.7% (base-case of 20%).

Finally, the independent sensitivity of each of those three variables was examined. The sensitivity of the project's 10-year NPV (7.7%) to individual changes in each of these three variables is represented in Figures C1, C2 and C3, below.

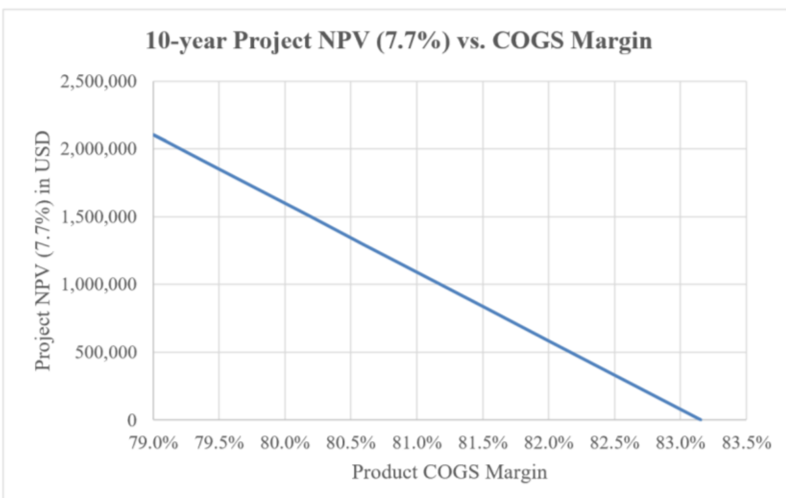

Figure C1. Decrease in Project's 10-year NPV (7.7%) with increasing COGS Margins

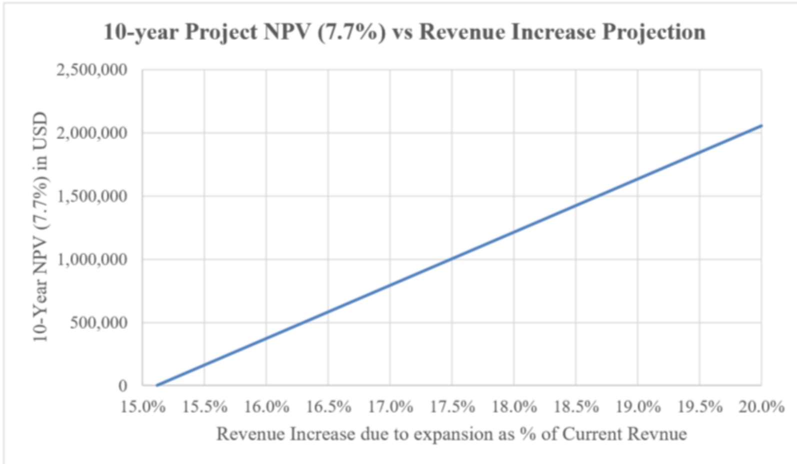

Figure C2. Project 10-year NPV(7.7%) values versus Revenue Increase Forecasts

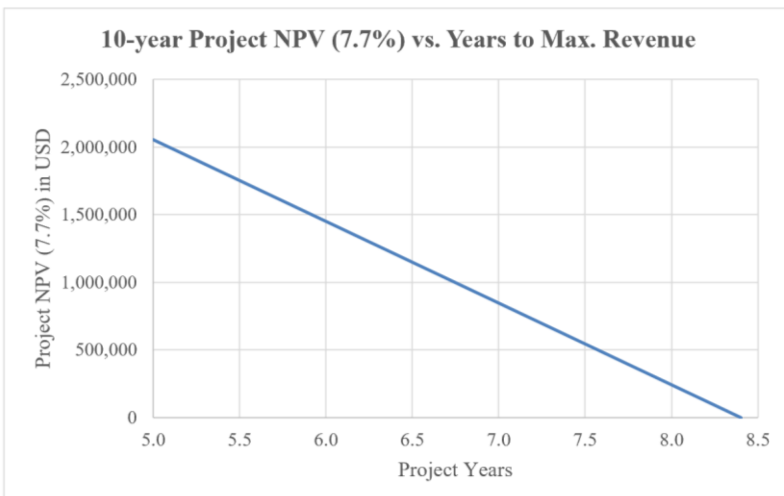

Figure C3. Decrease in Project's 10-year NPV (7.7%) with increasing Years to Maximum Revenue Realization

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CHAPTER 8: BOOK SUMMARY

Integrated Materials

This book an introduction to the philosophy and mechanics of performing financial analyses on projects. The materials provided are designed for the practitioner interested in learning the art and techniques of financially assessing a project. That practitioner may be a university student just learning the art or an employee desiring to assist their organization in making better, informed evidenced-based decisions. The book extends beyond the topic's conceptual introduction by providing enough "how to" details to allow the novice to advance from little understanding of financial analysis to being able to perform the tasks necessary to fully assess the financial impact of proposed projects.

The accelerated learning provided to the practitioner is accomplished in three ways. The first is the introduction of a generic approach to financially assessing projects. That approach is outlined in the next section. The second is the integration of this text with example spreadsheets and "how to" videos. These integrated materials, allow the reader can build their own spreadsheets, utilizing the templates and other spreadsheet materials provided, as they watch the videos.

The third way this material accelerates learning is through comprehensive example project financial analysis. All of the elements of a project financial analysis are applied to a single real-world example. This allows the reader to not only learn how to perform each task of a project financial assessment, but also to understand how all of the components combine.

Lastly, no project analysis is complete until its findings are communicated to the organization's decision-makers. Given that the analyst is typically not the organization's decision-maker, the topics of this book extends from the creation of the financial models to instructions on communicating the results of the analysis in a clear, concise, direct actionable and fact-based report.

The integrated materials provided combine this text with two important companion pieces: videos and Excel® documents. There are eight videos (see list below, Figure 8.1) that are referenced throughout this book. These videos provide step-by-step instruction using Excel® to perform various financial assessment tasks.

V2.1 Static Vs. Dynamic Spreadsheets
V2.2 Discounting Future Values
V4.1 Project NPV Calculations
V4.2 IRR using Goal Seek
V5.1 Project Finical Model Building
V6.1 Tornado Diagram Input Table
V6.2 Tornado Diagram Graphic Creation
V6.3 Project Success Conditions

Figure 8.1. List of Videos that integrate with this written document

All of the spreadsheets used in the videos, all the spreadsheets presented in the text, plus a number of templates (that are useful as starting points for projects) are included in the second companion piece. These individual worksheets (23 different worksheets in total) are organized into three Excel® workbooks. The first workbook, "Project_Finance_Videos_Spreadsheet_Compilation.xls," includes the spreadsheets utilized in all the videos plus a couple of generic templates. The inclusion of these spreadsheets allow the reader to gain skills by working in in Excel® in parallel with the video descriptions. The sequential tabs of that workbook are:

V2.1_Static_vs_Dynamic
V2.2_Discounting_Future_Values
V4.1_Project_NPV_Calculations
V4.2_IRR using Goal Seek
Project NPV Evaluation Template
Project Description
V5.1_Project Financial Model Building
V6.1_Tornado_Diagram Input
Tornado Diagram Template
V6.2_Tornado_Diagram_Graphic
V6.3_Success_Conditions

The second Excel® workbook, "Project_Finance_Chapter_Spreadsheets_&_Templates.xls," includes spreadsheets that appear in this text as well as templates utilized as a starting place for some of the tasks described herein. The sequential tabs of that workbook are:

Chapter 2
Chapter 4
Project NPV Evaluation Template
Tornado Diagram Template
WACC Calculation Template
WACC_Industry Averages 2022

The third workbook entitled "ACN_Free_Cash_Flow_Model_Data_0422.xls" contains information for Chapter 3. The first tab is a generic free cash flow model template that can be utilized with any downloadable income statement, balance sheet, and statement of cash flow for any firm. The workbook provides an example using data for Accenture (ticker: ACN) that was downloaded from http://financials.morningstar.com/income-statement/is.html?t=ACN&region=usa&culture=en-US. The sequential tabs of this workbook are:

ACN FCF Model
ACN Income Statement
ACN Balance Sheet
ACN Cash Flow

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Example-driven Approach

The first chapter of this book contains the introduction to the world of project financial analyses and introduces the project analysis approach that is utilized throughout this book. That generic approach to financially assessing projects is encompassed in the mnemonic, $QMCR^3$: Question, Measure, Calculate, then Recommendation, Risk, Relevant context.

- **Q**: What **Q**uestion are we trying to answer through this financial assessment?
  - There is always the "big question" of "do we move forward with this project or not?" but there is usually sub-questions pertaining to risk and determining the boundaries within which the project is financially viable, but beyond those boundaries the project is not financially viable.
- **M**: The second issue is what **M**easure will be utilized to address this issue?
  - The measure will be related to the question, of course, but for projects it invariably comes down to the project's Net Present Value (NPV). This measure, when appropriately done, allows all the firm's projects to be financially compared on a level playing field. Sensitivity of the project to its base-case NPV is typically part of the measured results. These measures will be discussed in Chapter 4.
- **C**: How to calculate those measure?
  - This text and corresponding videos and worksheets provides step-by-step methods to calculating the appropriate measures.
- $\mathbf{R^3}$
  - **R**: **R**ecommendation? What is the recommendation based on the analysis?
  - **R**: What are the **R**isks? Any recommendation that is made must be accompanied with a description of the project's specific risks. What are the successful bounds of the project? What does management need to focus on to make this project financially successful? In other words, under what conditions does this project financially viable?.
  - **R**: **R**elative context, if any. Is there context – background or history—that will help the decision-maker? Has the organization done this type of thing before or is it attempting to do something never before accomplished in the annals of human history?

The next two chapters provide background necessary to engage in financial analyses. Those topics include:

- Mathematics of Change
- Present Value of Future Cash
- Static versus Dynamic Spreadsheets, and a review of
- Financial Statements (Income Statement, Balance Sheet, Statement of Cash Flows)

Chapters 4, 5, 6 and 7 illustrate the methods by carrying a single example across all those chapters. This approach allow the user to connect-the-dots in the analysis approach. The example culminates in Chapter 7 with the creation of an example report on the hypothetical project. That reporting is an important part of the analysis as obtaining insights without being able to communicate those insights to the appropriate decision-maker in the organization is tantamount to not never having acquired any insights in the first place. The last thing a financial analyst desires is to see their hard work ignored because it was not communicated in a way that was comprehensible by the decision-makers.

Developing a new skill takes practice. The integrative materials presented are intended to provide the practitioner with the initial understanding and practice required to develop begin that skill-development. Expertise comes from continual skill-refinement acquired through practice.

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