

To face up to the challenges of the globalized world, future CEOs must have a thorough understanding of Engineering Finance to get the most 'cost-efficient' project design and thus obtain the 'optimum' possible yield for the project.

# FINANCIAL MODELING

FOR ENGINEERS & ACCOUNTANTS *Made Easy*<sup>TM</sup>



A MADE EASY METHODOLOGY IN THE CONSTRUCTION OF THE  
**TECHNO-FINANCIAL MODEL**<sup>TM</sup>  
TO DETERMINE THE FINANCIAL VIABILITY OF PROJECTS

Assoc. Prof. DR. Ir. MAULUD Latif

**“...very few books, if any, were written by engineers on financial modeling. It is thus financial modeling MADE EASY for the non-financially savvy. This book is focused on the input to the financial models, which is invariably, technical in nature. It is a must-have for engineers and non-engineers alike, who aspire not only to ensure the financial viability of a project but also enhancing its yield...”**

***The Author***

***Professor of Hydrogen Finance  
Head - Renewable Energy Policy and  
Financial Modeling Studies  
Institute of Hydrogen Economics  
Universiti Teknologi Malaysia***

**“Businesses of the future will require new strategies, innovation and creativity to ensure their competitiveness. Engineering Finance gives a new and innovative way of developing a viable business model by integrating engineering, finance and other parameters to ensure a viable business and meet project objectives in a very simplified approach...”**

***Prof DR Hamdini Saidl  
The Advisor***

***Executive Director,  
Energy Research Alliance and Chairman,  
Institute of Hydrogen Economics  
Universiti Teknologi Malaysia***

TUN DR. MAHATHIR MOHAMMAD

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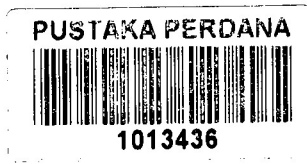
Assoc. Prof. DR. Ir. MAULUD Latif

*YAB Tun Dr Mahathir*

*THANK you for your contribution.  
to nation & religion.*

*May Allah s.w.t Bless you & family.*

*Maulud*



*1 March 2012*



# Financial Modeling for Engineers & Accountants Made Easy™

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Perpustakaan Negara Malaysia

Cataloguing-in-Publication Data

Abdul Maulud Abdul Latif, 1952-

Financial modeling for engineers & accountants made easy /

Maulud Latif.

Bibliography p. 309

ISBN 978-967-10680-0-7

1. Financial engineering. 2. Accounting. I. Title.

658.15

First published in 2012.

Printed in Malaysia.

658.15  
ABD

# DEDICATION

In unreserved dedication to my beloved wife, children and family. It is their understanding, patience, undying love and continuing support that have made this book possible.

I also dedicate this book to my (late) parents for their unremitting guidance and upbringing, cultured forever with the never-ending quest for knowledge and success. May Allah swt Bless Their Souls.

# WORDS OF WISDOM

“It (wisdom) is from God, so hear!; And to God do you return!

When you hear what I bring, **Learn!**

Then, with understanding, see

The details in the whole; And also see them as part of the whole (**Practice**)

Then give it to those who seek it, and stint not (**Teach**)

This is the mercy that Encompass you; so extend it”

*Shaykh al Akbar Muhiyy'd Ibn al-Arabi*

*Murcia (Spain) 1165 – Damascus (Lebanon) 1240*

\* \* \* \* \*

Ask God only Three Things, and No More:

Health;

Wealth;

Wisdom\*;

God Gives; And God Takes. So Beware!

\* Please refer to Figure 2.3 in Chapter 2.

*Assoc. Professor DR Ir Maulud Hj Latif*

*Kuala Lumpur (Malaysia) 2011*

# ACKNOWLEDGEMENT

This book is an extract of the Engineering Doctorate thesis (2005) entitled “*The Development of A Business Framework and Techno-Financial Model for Biomass Power Plants*” submitted to the Universiti Teknologi Malaysia (in collaboration with the University of Warwick, Britain).

In the course of conducting the research, and thus this book, I was in contact with many people, researchers, academicians and industrialists. They have made invaluable contributions towards my understanding of the subject and the preparation of the book. I would also like to thank others, too many to mention, for their invaluable support and encouragement including equipment suppliers, consultants and bankers in various organizations in Malaysia, Britain, Indonesia, Thailand and India who have made equally invaluable contributions and suggestions.

My deepest gratitude also to Professor Dr Hamdani Saidi <sup>a</sup>, my academic supervisor and Chairman at the Institute Hydrogen Economics, and Dr Mohd Zamzam Jaafar <sup>b</sup>, my industrial supervisor, for their patience and relentless guidance.

I am also indebted to the Institute Hydrogen Economics, Universiti Teknologi Malaysia, for being supportive of my effort.

Last but not least, to all my friends for their invaluable support and encouragement.

---

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# ABOUT THIS BOOK...

## ***Objectives are to Create Cost Conscious Global Professionals...***

The super-ordinate objective of this Engineering Finance™ methodology is to create cost-conscious Global Professionals. Of course, to explain this is not easy, so I will illustrate with one simple exercise, as follows: If you want to implement a project, you need to get a bank loan. Thus, you have to convince at least two parties: (a) Company board of directors and (b) the bankers. The basic question that these folks will ask are:

Question #1: How viable are the proposals? (Project IRR, payback period)

Question #2: What do you want? (Line of Credit and Equity & Capital Structure)

**Thus, the gist of this book is mainly towards building a financial model to answer these two basic questions.**

In order to answer these questions, you must compute the Internal Rate of Return, payback period and also the “Equity and Capital Structure” (Line of Credit). So if you want to go to the bank to borrow money to finance your project, please read this book first.

## ***Basis of This Book... New Methodology...***

The foundation of this book is based on the Engineering Finance methodology that I have created during the course of my Engineering Doctorate research. It is backed by more than 30 years of experience in various multi-disciplinary fields from engineering to finance and marketing to corporate turnaround, practiced regionally in Malaysia, Indonesia, Australia and India.

## ***Controversial Subject...***

Engineering Finance is indeed a controversial subject. Most new subjects are controversial from the onset. Many years ago, the subject of “Mechatronics” which is an amalgamation of two subjects, “mechanical” and “electronics”, was also

regarded as a “controversial” subject. It is considered as neither “mechanical” nor “electronics”. In fact, it is a combination of both. And today, professionals in this subject are well sought after, not only in the automobile industry which is creating new vehicles in the green energy sector, but also in banks that wish to automate routine daily task such as dispensing of cash (Automated Teller Machines) etc.

Another subject is “Financial Engineering”. This is the use of “engineering” methodology in “finance” such as for share swap, merger and acquisitions, bonds, etc. MBA graduates with Financial Engineering qualifications are much sought after especially by merchant banks that are involved in bonds, share swaps and mergers and acquisitions.

Similarly, I hope to make this Engineering Finance methodology much sought after in the future not only amongst MBA-ians, accounting and finance students but even more so amongst professionals such as engineers (in particular) and even Human Resources. Professionals holding post such as Directors, Project Managers, etc. will find it very useful, I’m sure.

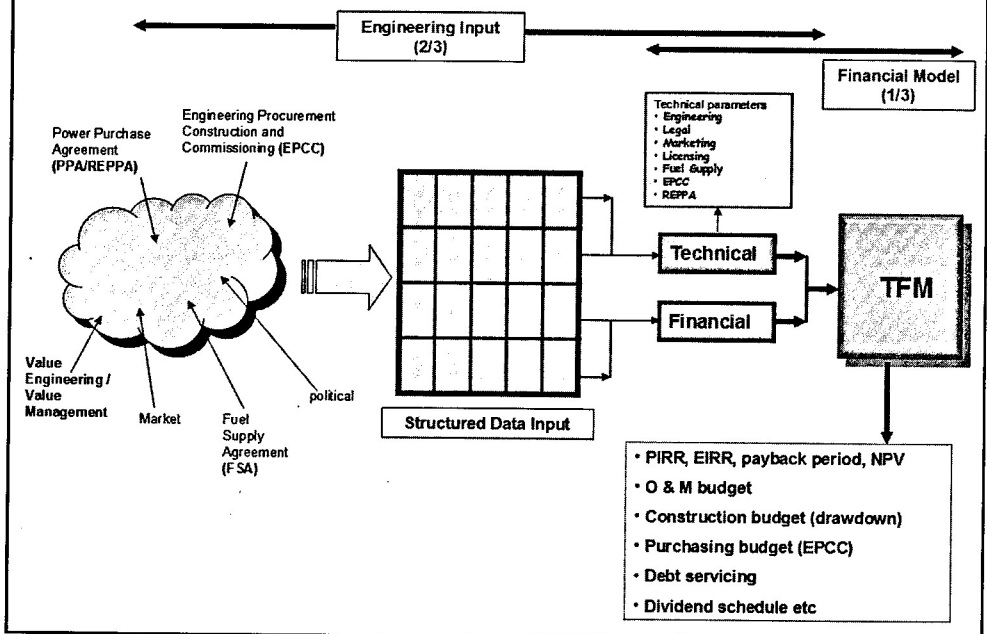
### ***What This Book is NOT About...***

I have read a lot of books on similar subjects. The primary difference of this book compared to the others is that the others emphasize on the use of the spreadsheet in building models. This book doesn’t. This book is not about finance; neither it is about accounting. It is also not about learning how to use the Excel financial spreadsheet. However, accounting, finance and knowing how to use the spreadsheet are the foundations of this subject. So please go read some books on those subjects before you read this book.

### ***Emphasis on (Engineering) “Input”; Not Model Building per se...***

This book is about the “Input” in constructing financial models to determine the financial viability of projects. Remember the lingo “GIGO” - Garbage-In; Garbage-Out? Well, even if you have a beautiful financial model but if your “Input” is not valid and reliable, then invariably the “output” will be equally garbage. I would like to emphasize the word “Input” as shown in the figure below. Thus, my subject is more about the input of the modeling process. Two-third of the book is about engineering input and the rest is about the model-building process itself.

## DECISION MAKING PROCESS IN THE CONSTRUCTION OF THE FINANCIAL MODEL



However, if you do not have the foundations, don't worry as this book is written in a "Made Easy™" format.

The financial model computes the Project IRR, Equity IRR, payback period, etc. to determine the project financial viability (this will answer Question #1). The model is articulate so it can generate multi-user report or "Output" for use by many users such as Construction Managers, Operations & Maintenance Managers as well as Bankers (this will answer Question #2).

The input to the financial model amalgamates both the "Financial" and "Technical" data. Thus, I like to call it Techno-Financial Models™ or TFM. The TFM is the basic tool in "Engineering Finance".

### **Engineering Finance to Produce "Globalized Professionals"...**

The future world is a globalized world; it is a highly competitive world. Professionals have to be "Globalized Professionals" rather than merely "Professionals". Engineering Finance is the methodology created by the author to transform professionals towards this globalization phenomenon. Thus, Engineering Finance is described as the "bridge" that bridges the gap between "Engineering" and

“Finance”. Engineering Finance is thus defined as: Engineering using financial methodology to create a “cost efficient” project design. Techno-Financial Model (TFM) is the tool to determine the long-term financial viability of projects to be implemented. It is about increasing project returns and enhancing wealth.

**“Financial Modeling for Engineers & Accountants Made Easy”** is not only for engineers. Accountants and all those involved in business development and project implementation will find it equally useful. It is a “must-have” handbook for Chief Executives, Directors and Project Managers, and for students in MBA courses, post graduates taking courses in engineering business management, project management, engineering economics and financial engineering. It is a handy reference in conducting the financial viability studies and preparation of the construction and operational budget. It is also used to determine the Critical Components that could undermine the financial viability of the project.

### **Global “Made Easy” Textbook...For Globalized Professionals**

This book is intended to be a standard textbook for students all over the world. Therefore, it is written in simple, easily understood language. The model examples given are also made simple so that students will be able to understand the basic concept essential in financial modeling. As the name suggests, modeling here involves basic building blocks. Sophistication comes (later) in building the model during actual project planning, and modifying and improving it during project implementation. The basic concept in building the financial model is “block building”.

### **Cross Border “Made Easy” Book...**

The book is made easy so that it crosses the borders of “engineering” and “finance”. The math is kept simple, making the book accessible to non-financial personnels. Computation of financial ratios relevant to financial modeling is computed on standard spreadsheet program, amongst them IRR, NPV, payback period, working capital requirements and Interest During Construction (IDC) computation.

### **New Terminologies...**

This book contains new terminologies to date not found in any discipline, for example, Engineering Finance, Techno-Financial Model, Critical Component (Analysis) and Cost Efficiency Model. Update yourself with these new financial terminologies.

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### ***How to Read This Book...***

First, read all the six chapters of part A to understand the concept of Engineering Finance and building financial model; then read one of the five case studies in Part B that interests you and understand it well, relating to the theories and tips in part A; and finally, read the Conclusion in part C. If you wish, you could go back to read more of the other case studies to give you a broader picture of financial modeling with other projects.

# Financial Modeling for Engineers & Accountants Made Easy

## Part A

### Engineering Finance and Techno-Financial Model

**Chapter 1**  
Introduction to Engineering Finance

**Chapter 2**  
Simple Steps in Constructing Financial Model

**Chapter 3**  
Business Framework of Engineering Finance

**Chapter 4**  
Uses of Techno-Financial Model

**Chapter 5**  
Techno-Financial Model Structure

**Chapter 6**  
Financial Ratios and Model Construction

## Part B

### Case Studies

**Chapter 7**  
Biomass Power Plant

**Chapter 8**  
Biodiesel Plant

**Chapter 9**  
Coal Mining

**Chapter 10**  
Service Apartment

**Chapter 11**  
Landed Property

## Part C

### Conclusion

#### Chapter 12

Conclusion

# LIST OF ABBREVIATIONS

CCA	Critical Component Analysis
CCGT	Combined Cycle Gas Turbine
CFC	Critical Financial Component
CTC	Critical Technical Component
CP	Condition Precedent
CPO	Crude Palm Oil
CPA	Critical Path Analysis
DSCR	Debt Service Cover Ratio
EF	Engineering Finance
EFB	Empty Fruit Bunch
EPCC	Engineering, Procurement, Construction & Commissioning
FFB	Fresh Fruit Bunch
FSA	Fuel Supply Agreement
GHG	Green House Gases
GWh	Gigawatt hour
hc	Hectare
IPP	Independent Power Producers
IRR	Internal Rate of Return
JSG	Joint and Several Guarantees
kt	Kiloton
kWh	Kilowatt hour
KPI	Key Performance Indicator
LCO	Letter of Conditional Offer
LFG	Liquefied Fuel Gas
LNG	Liquefied Natural Gas
Mj/kg	Megajoule per kilogram
Mm <sup>3</sup>	Million cubic meter
Mt	Metric ton
mmBTU	Million British Thermal Unit
MTG	Microturbine generator
Mtoe	Million tons oil equivalent
Mton	Million tons

MW	-	Megawatt
NPAT	-	Net Profit After Tax
NPBT	-	Net Profit Before Tax
O&M	-	Operation and Maintenance
OER	-	Oil Extraction Rate
PFC	-	Principal Financial Components
POME	-	Palm Oil Mill Effluent
pv	-	Photovoltaic
RE	-	Renewable Energy
REPPA	-	Renewable Energy Power Purchase Agreement
RET	-	Renewable Energy Technologies
RM	-	Ringgit Malaysia * please see footnote below
RPS	-	Renewables Portfolio Standard
ROE	-	Return on Equity
ROI	-	Return on Investment
SPV	-	Special Purpose Vehicle
TCE	-	Total Capital Employed
TEM	-	Techno-Economic Model
TFM	-	Techno-Financial Model
USD	-	United States Dollar

The foreign currency exchanges used throughout this book (2005) are as follows:

Foreign Currency	Ringgit Malaysia (RM)
USD1.00	3.80
Euro1.00	4.50
GBP1.00	6.80

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# PART **A**

## **ENGINEERING FINANCE AND TECHNO-FINANCIAL MODEL**

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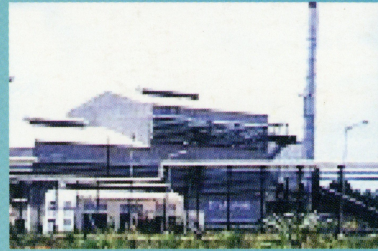
In Part A, Chapter 1 introduces Engineering Finance, its concept and definition. Chapter 2 and 6 give a step-by-step methodology of constructing the Financial Model to compute the Internal Rate of Return (IRR) and the payback period. Also included is the computation of relevant financial ratios such as Interest During Construction, Working Capital (Wcap), Fund Drawdown Curve or “S” curve. Chapter 3 and 4 deal with the applications of Techno-Financial Models. Chapter 5 introduces the structure of the Techno-Financial Model.



## WHAT IS IT? – DEFINITION

This book makes it easy for engineers and accountants to understand how to construct Financial Models to determine, amongst others, project IRR and payback period. The basic technology involved in Financial Modeling is Engineering Finance.

Engineering Finance can be described as the “bridge” that bridges the gap between “Engineering” and “Finance”, a branch of engineering adopting financial modeling techniques to deliver project designs that are cost-efficient and financially viable. The tool for Engineering Finance™ is the Techno-Financial Model (TFM). This book is a simplified methodology in constructing the TFM.



## WHO USES THIS BOOK?

Essentially for:

- MBA students
- Masters and Doctoral Engineering students
- Executive Development Program courses
- Project Managers / Directors
- Chief Executive Officers / Managing Directors

Also for Accountants and those involved in business development and project implementation.



## APPLICATIONS OF FINANCIAL MODEL

- Determine the financial viability of projects – IRR, payback period, etc.
- As a negotiating tool in raising of fund, negotiating prices of capital equipment, fuel supply and O&M.
- Determine the Critical Components (Critical Component Analysis) that undermine the financial viability of the project.
- As a Construction Budget to monitor project implementation.
- As an Operational Budget to ensure operation is as budgeted.
- As a “Risk Assessor” to determine the risk in implementing the project and formulate “When to Exit” strategy.
- Consider Location Option in siting projects.
- Consider Technology Options in selection of equipments.
- Consider Product Options in implementing projects.

ISBN 978-967-10680-0-7



9 789671 068007

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