

Whole Life Costing

A new approach

Peter Caplehorn

Whole life costing

A new approach

Peter Caplehorn



First published 2012
by Routledge

2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN

Simultaneously published in the USA and Canada
by Routledge
711 Third Avenue, New York, NY 10017

Routledge is an imprint of the Taylor & Francis Group, an informa business

© 2012 Peter Caplehorn

The right of Peter Caplehorn to be identified as author of this work has been asserted by him in accordance with sections 77 and 78 of the Copyright, Designs and Patents Act 1988.

All rights reserved. No part of this book may be reprinted or reproduced or utilised in any form or by any electronic, mechanical, or other means, now known or hereafter invented, including photocopying and recording, or in any information storage or retrieval system, without permission in writing from the publishers.

This publication presents material of a broad scope and applicability. Despite stringent efforts by all concerned in the publishing process, some typographical or editorial errors may occur, and readers are encouraged to bring these to our attention where they represent errors of substance. The publisher and author disclaim any liability, in whole or in part, arising from information contained in this publication. The reader is urged to consult with an appropriate licensed professional prior to taking any action or making any interpretation that is within the realm of a licensed professional practice.

Trademark notice: Product or corporate names may be trademarks or registered trademarks, and are used only for identification and explanation without intent to infringe.

British Library Cataloguing in Publication Data

A catalogue record for this book is available from the British Library

Library of Congress Cataloging in Publication Data

Caplehorn, Peter.

Whole life costing: a new approach / Peter Caplehorn.

p. cm.

Includes index.

I. Building – Costs. 2. Life-cycle costing. I. Title.

TH435.C355 2012

658.20068'1 – dc23

2011041914

ISBN: 978-0-415-43422-5 (hbk)

ISBN: 978-0-415-43423-2 (pbk)

ISBN: 978-0-203-88896-4 (ebk)

Typeset in Garamond
by Taylor & Francis



Printed and bound in Great Britain by
TJ International Ltd, Padstow, Cornwall

Whole life costing

Whole life costing has been waiting to come of age for many years. A subject that was previously of mainly academic interest is now becoming a key business tool in the procurement and construction of significant projects.

With the advent of public–private partnerships (PPP), and in particular of the private finance initiative (PFI), details of a project’s life need to be assessed and tied in to funding and operational plans. Many projects run to millions of pounds and are of high political or social importance, so the implications of the life of materials are crucial. A fundamental requirement of these procurement routes has been that the whole enterprise should be included within the bid, so that a company takes on not only the construction, but also the running and maintenance, of any building.

Additionally, as sustainability has emerged and grown in importance, so has the need for a whole life time-costing approach, driven partly by government insistence. At the heart of sustainability is an understanding of what the specification means for the future of the building and how it will affect the environment. *Whole Life Costing* considers part of this and provides an understanding of how materials may perform and what allowances are needed at the end of their life.

This book sets out the practical issues involved in the selection of materials, their performance, and the issues that need to be taken into account. The emphasis, unlike in other publications, is not to formularise or to package the issues but to leave the reader with a clear understanding and a sensible, practical way of arriving at conclusions in the future.

Peter Caplehorn is Technical Director at Scott Brownrigg. He is responsible for technical standards across the company, currently on projects currently worth more than £2 billion. He writes regularly for *Building* magazine and the RIBA Journal and lectures regularly on construction matters.

Now part of Routledge Building & Construction

Building Construction Handbook (9th Edition)

Roy Chudley and Roger Greeno

The *Building Construction Handbook* is an authoritative reference for all construction students and professionals. It is full of detailed drawings that clearly illustrate the construction of building elements. The principles and processes of construction are explained with the concepts of design included where appropriate. Extensive coverage of building construction practice and techniques, representing both traditional procedures and modern developments, are also included to provide the most comprehensive and easy to understand guide to building construction.

September 2012 | 884pp | Pb: 978-0-08-097061-5 | £24.99

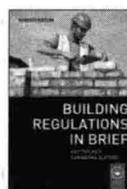


Building Regulations in Brief (7th Edition)

Ray Tricker and Sam Alford

A ready reference giving practical information, it enables compliance in the simplest and most cost-effective manner possible. *Building Regulations in Brief* cuts through the confusion to explain the meaning of the regulations, their history, current status, requirements, associated documentation and how local authorities view their importance, as well as emphasizing the benefits and requirements of each regulation.

February 2012 | 1056pp | Pb: 978-0-415-80969-6 | £28.99

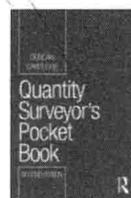


Quantity Surveyor's Pocket Book (2nd Edition)

Duncan Cartledge

Now substantially revised and fully up-to-date with NRM1, NRM2, and JCT (11), the *Quantity Surveyor's Pocket Book* remains the essential reference for newly qualified and student quantity surveyors. Outlines all of the practical skills, contractual and management techniques needed in the profession with a no-nonsense approach.

June 2012 | 440pp | Pb: 978-0-415-50110-1 | £18.99



Building Services Handbook (6th Edition)

Roger Greeno and Fred Hall

This essential resource explores the application of all common elements of building services in an accessible, highly illustrated style. New material includes information on water system components, control systems for hot water and heating, ventilation and air conditioning, drainage and more.

April 2011 | 720pp | Pb: 978-0-08-096982-4 | £24.99



To Order: Tel: +44 (0) 1235 400524 Fax: +44(0) 1235 400525

or Post: Taylor and Francis Customer Services,

Bookpoint Ltd, Unit T1, 200 Milton Park, Abingdon, Oxon, OX14 4TA

Email: book.orders@tandf.co.uk

For a complete listing of all our titles visit:

www.routledge.com

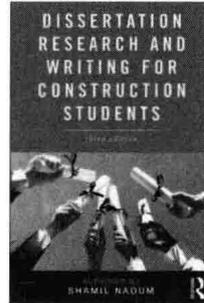
 **Routledge**
Taylor & Francis Group

ESSENTIAL READING FROM ROUTLEDGE

3rd Edition

Dissertation Research and Writing for Construction Students

S.G. Naoum



- User-friendly, easy to dip into guide for all Built Environment students.
- Takes the reader from the stage of choosing a topic to writing a well-structured dissertation.
- Best case practice illustrated with numerous examples, case studies and references.

Dissertation Research and Writing for Construction Students covers topic selection, research planning, data collection and methodology, as well as structuring and writing the dissertation - in fact, everything needed for a successful write-up.

A new section advising students on the use of the SPSS software package 'Statistical Analysis for Social Sciences' will help readers make the best use of this tool. New examples and references ensure that this new edition of the bestselling construction dissertation guide is right up to speed with current practice.

This is the ideal resource for students involved in research in construction management, building and quantity surveying.

Contents:

1. Introduction **Part 1: Preparing the Ground and Reviewing the Literature** 2. Selecting a Topic and Writing the Dissertation Proposal 3. Reviewing the Literature **Part 2: Research Design and Methodology** 4. Approaches to Data Collection 5. Techniques for Data Collection 6. Questionnaire Construction **Part 3: Analysis and Preparation of the Results** 7. Measurements and Probability 8. Analysis of the Results 9. Structuring and Writing the Dissertation 10. Dissertation Supervision and Assessment. **Appendices** 1. Examples of Dissertation Proposals 2. London South Bank University: Example of a Questionnaire 3. Statistical Tables 4. Construction Industry Employee Injury Statistics 5. Using SPSS 6. Example of Presenting Interview Results in a Tabulated Format

July 2012: 208pp

Pb: 978-0-415-53844-2: **£21.99**

To Order: Tel: +44 (0) 1235 400524 Fax: +44(0) 1235 400525

or Post: Taylor and Francis Customer Services,

Bookpoint Ltd, Unit T1, 200 Milton Park, Abingdon, Oxon, OX14 4TA

Email: book.orders@tandf.co.uk

For a complete listing of all our titles visit:

www.routledge.com

 **Routledge**
Taylor & Francis Group

ESSENTIAL READING FROM ROUTLEDGE

Understanding JCT Standard Building Contracts 9th Edition

David Chappell



This ninth edition of David Chappell's bestselling guide has been revised to take into account changes made in 2011 to payment provisions, and elsewhere. This remains the most concise guide available to the most commonly used JCT building contracts: Standard Building Contract with quantities, 2011 (SBC11), Intermediate Building Contract 2011 (IC11), Intermediate Building Contract with contractor's design 2011 (ICD11), Minor Works Building Contract 2011 (MW11), Minor Works Building Contract with contractor's design 2011 (MWD11) and Design and Build Contract 2011 (DB11).

Chappell avoids legal jargon but writes with authority and precision. Architects, quantity surveyors, contractors and students of these professions will find this a practical and affordable reference tool arranged by topic.

Contents:

1. Contractor's Obligations
2. Insurance
3. Third Parties
4. Work in Progress
5. Money
6. Claims
7. The End
8. Dispute Resolution

March 2012: 160pp

Pb: 978-0-415-50890-2: **£24.99**

To Order: Tel: +44 (0) 1235 400524 **Fax:** +44(0) 1235 400525
or Post: Taylor and Francis Customer Services,
Bookpoint Ltd, Unit T1, 200 Milton Park, Abingdon, Oxon, OX14 4TA
Email: book.orders@tandf.co.uk

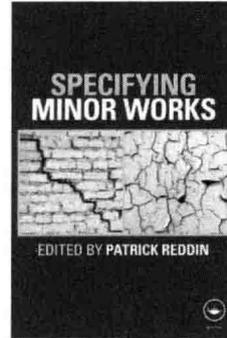
For a complete listing of all our titles visit:
www.routledge.com

 **Routledge**
Taylor & Francis Group

ESSENTIAL READING FROM ROUTLEDGE

Specifying Minor Works

Edited by Patrick Reddin



Efficient maintenance of a property requires a reliable assessment for defects or inadequacies and a systematic method for dealing with them. This book provides the information you'll need for both. Starting with a holistic view, bringing together the two lives of a building – the life of the construction and the life of the occupied property – you'll be guided through the process from observation to execution.

Throughout the specification process, all manner of issues face the surveyor, property manager or building engineer, from describing common defects to addressing energy efficiency and carbon emissions. In addition to these tasks the book also deals with:

- guidance on equipment
- prioritizing works
- the practicalities of specification
- building control
- contract selection
- health and safety.

Helping you navigate bureaucracy as well as tackling the practical challenges safely and effectively, this is a crucial guide for building engineers, surveyors, contractors and property managers.

Contents:

1. Statutory Control 2. Listed Buildings and Conservation Areas 3. Sustainability 4. Neighbour Issues 5a. Foundations, Walls, Floors 5b. Roofs 5c. Drainage 6. Pre-Contract 7. Specification 8. Post-Contract

October 2012: 160pp

Pb: 978-0-415-58351-0: £29.99

To Order: Tel: +44 (0) 1235 400524 **Fax:** +44(0) 1235 400525
or Post: Taylor and Francis Customer Services,
Bookpoint Ltd, Unit T1, 200 Milton Park, Abingdon, Oxon, OX14 4TA
Email: book.orders@tandf.co.uk

For a complete listing of all our titles visit:
www.routledge.com

 **Routledge**
Taylor & Francis Group

ESSENTIAL READING FROM ROUTLEDGE

Understanding JCT Standard Building Contracts *9th Edition*

David Chappell



This ninth edition of David Chappell's bestselling guide has been revised to take into account changes made in 2011 to payment provisions, and elsewhere. This remains the most concise guide available to the most commonly used JCT building contracts: Standard Building Contract with quantities, 2011 (SBC11), Intermediate Building Contract 2011 (IC11), Intermediate Building Contract with contractor's design 2011 (ICD11), Minor Works Building Contract 2011 (MW11), Minor Works Building Contract with contractor's design 2011 (MWD11) and Design and Build Contract 2011 (DB11).

Chappell avoids legal jargon but writes with authority and precision. Architects, quantity surveyors, contractors and students of these professions will find this a practical and affordable reference tool arranged by topic.

Contents:

1. Contractor's Obligations
2. Insurance
3. Third Parties
4. Work in Progress
5. Money
6. Claims
7. The End
8. Dispute Resolution

March 2012: 160pp

Pb: 978-0-415-50890-2: **£24.99**

To Order: Tel: +44 (0) 1235 400524 **Fax:** +44(0) 1235 400525
or Post: Taylor and Francis Customer Services,
Bookpoint Ltd, Unit T1, 200 Milton Park, Abingdon, Oxon, OX14 4TA
Email: book.orders@tandf.co.uk

For a complete listing of all our titles visit:
www.routledge.com

 **Routledge**
Taylor & Francis Group

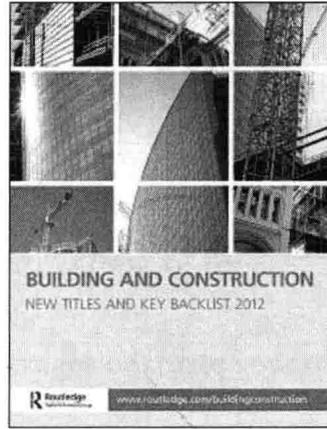
NEW CATALOGUE FROM ROUTLEDGE

Building and Construction

New Titles and Key Backlist 2012

Browse online at:

www.routledge.com/catalogs/building_and_construction



2011 was quite a year for our construction list, with the acquisition of hundreds of excellent titles from Butterworth Heinemann, Earthscan, and Newnes on top of the continued expansion of the existing SPON Press program. The resulting construction "super group" has this year been rebranded under the prestigious Routledge imprint, where it joins our Planning and Architecture books.

So we entered 2012 expanded and rebranded. In the pages of this Routledge Building and Construction catalogue you will find some new editions of our long-running classics (such as the ninth edition of *Understanding JCT Standard Building Contracts* and the second edition of *Portfolio and Program Management Demystified*), some renowned imports (*Building Construction Handbook* and the *Quantity Surveyor's Pocket Book*), and a host of brand new titles written by an everexpanding pool of world-class authors, not to mention the growing number of cutting edge IHS BRE Press publications we have been distributing worldwide for close to two years now.

Make sure you subscribe to our e-alerts, Twitter, and Facebook for instant updates on our activities.

There is much more to come from us in 2012!

To Order: Tel: +44 (0) 1235 400524 Fax: +44(0) 1235 400525
or Post: Taylor and Francis Customer Services,
Bookpoint Ltd, Unit T1, 200 Milton Park, Abingdon, Oxon, OX14 4TA
Email: book.orders@tandf.co.uk

For a complete listing of all our titles visit:
www.routledge.com

 **Routledge**
Taylor & Francis Group

Taylor & Francis

eBooks

FOR LIBRARIES

ORDER YOUR
FREE 30 DAY
INSTITUTIONAL
TRIAL TODAY!

Over 23,000 eBook titles in the Humanities, Social Sciences, STM and Law from some of the world's leading imprints.

Choose from a range of subject packages or create your own!

Benefits for
you

- ▶ Free MARC records
- ▶ COUNTER-compliant usage statistics
- ▶ Flexible purchase and pricing options

Benefits
for your
user

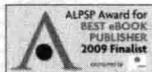
- ▶ Off-site, anytime access via Athens or referring URL
- ▶ Print or copy pages or chapters
- ▶ Full content search
- ▶ Bookmark, highlight and annotate text
- ▶ Access to thousands of pages of quality research at the click of a button

For more information, pricing enquiries or to order a free trial, contact your local online sales team.

UK and Rest of World: online.sales@tandf.co.uk

US, Canada and Latin America:
e-reference@taylorandfrancis.com

www.ebooksubscriptions.com



Taylor & Francis eBooks
Taylor & Francis Group



A flexible and dynamic resource for teaching, learning and research.

Contents

<i>List of figures</i>	vii
1 Introduction	1
2 Context of whole life costing	6
3 Sustainability, energy and waste	16
4 The rational analysis	20
5 Value of whole life assessment	26
6 How does this play out in real projects?	31
7 History – how did we get here?	39
8 Ageing and associated factors	44
9 The process of procurement	48
10 A material matter	52
11 Construction methods	65
12 Observations outside the world of construction: whole life value and cost	69
13 Fashion	72
14 Predicting the future	75
15 The ten-point strategic plan	80
16 Key players	85
17 Client experiences	95

vi Contents

18	Redefining the future	100
19	Searching for the ideal process	104
20	Whole life costing: is there an end game?	107
21	The underlying principle: entropy	114
22	Carbon whole life cost	116
23	Recommendations	122
24	Final thoughts	130
	<i>Index</i>	131

Figures

1.1	The project life cycle	2
1.2	Project costs	4
2.1	PFI disconnection	11
2.2	Procurement	13
2.3	Dilution of specification	14
4.1	Value/cost balance	21
5.1	Supply-chain issues	27
5.2	Influences by third parties	28
8.1	Issues expanding out as a chain of actions	45
10.1	Construction and maintenance issues	63
10.2	Life issues 'move' the Building away from the planned path	63
18.1	Keeping on the right path with gateways to correct deviations	102
20.1	What's needed?	113
21.1	Bow-tie diagram	115
22.1	Carbon parallels whole life issues	121
23.1	Key points and feedback to each stage	124
23.2	BIM working	126

Introduction

I have been a qualified chartered architect for over 30 years, and in that time I have designed and overseen the construction of countless projects. In the main, these have been commercially based schemes, ranging from individual or complex apartment blocks, town-centre schemes, offices and schools through to industrial complexes and airports.

Through that experience, I have been involved in detailed work to develop the best solutions for the client and to ensure that the answers provided are regulation-compliant and best value for money.

I have always been interested in the balance between good design and functional excellence. The skills the designer needs to conceive the best solution are considerable – however, in this increasingly complex world, we also need to be able to convince the client and the construction team that the design is valid, practical, good value, and therefore viable.

However, the result of this process often involves a compromise as a result of the many debates and pressures that affect the construction industry today. These may sometimes play out positively, but often negatively, and we all are the poorer for it.

I have always considered the technical and practical aspects of the profession to be the most challenging. ‘Form follows function’ has been the mantra of many an architect, and is as valid today as ever.

Throughout the whole of my career, I have been concerned over the use or misuse of materials and the squandering of energy. In the early part of the twenty-first century, we seem to have returned to the same issues that I started out with in the 1970s, when Schumacher, Brenda and Robert Vale, Alex Pike and others were making the case for more rational use of resources. We are now revisiting many of these principles under the heading of sustainability and – possibly humanity’s single greatest challenge – taming the use and proliferation of carbon (and related gases) and its effects on our planet’s climate.

I hope, through this discussion of some of the aspects of whole life values, to develop this debate into a more considered and applied approach that will deliver some tangible and meaningful results.

The need for whole life costing

There has long been a need for greater understanding of materials and resources, and how we use them. As with many issues in the construction industry, this question has been hijacked by third parties, in this case the ‘whole life costing lobby’.

2 Introduction

In theory, this has produced a raft of information that is supposed to identify the life of the cost of a building, and the cost of the life of that building.

In the real world, however, this is rarely relevant – the normal outcome is to pare costs to the bone, or to justify poor material choices. By the time the results of these decisions have surfaced, those who made them are long gone, possibly retired. We therefore have the construction equivalent of the ‘emperor’s new clothes’.

This book attempts to clarify this central challenge and to offer some solutions to this dilemma. This is a book rooted firmly in the real world, confronting the real challenges that affect construction professionals on a daily basis. It is intended as a management and project guide that will offer real benefits to projects in the future. It offers:

- an explanation of the workings of the construction industry today
- an account of how circumstances have developed in combination with the practicalities of construction
- some key principles to ensure that sensible analysis can be undertaken to arrive at a real whole-value view of a project.

These factors all have a foundation in financial issues, but are all practical and quantifiable.

So why is life-cycle costing so rooted in money? I suggest that this is largely because the issues involved have been taken over by the financial part of the industry. The client’s ear is always open to money matters, and whole life values in themselves are difficult to get on the agenda. We are therefore left with an analysis that is largely removed from the real, practical, everyday world, and will mainly be public relations (see Chapter x). Central to the practicalities of this subject is the characteristic of ageing.

Why is whole life costing important?

Today, so much of what we construct is based on a short-term perspective, and the cost plan is completely dominant. Most project models, especially in the commercial world,

Chronology of a project

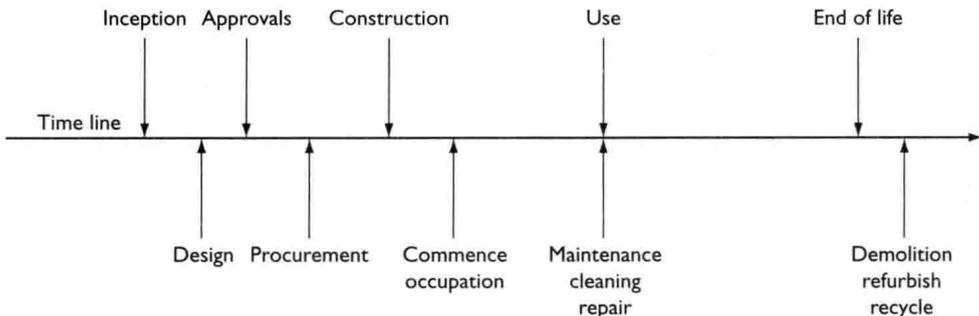


Figure 1.1 The project life cycle

are formulated around the principle of units and the cost of those units. These are later developed into elemental costs, and then into a cost plan.

For many designers, this is unhelpful and disjointed, the relationship of the cost plan and the design being entirely out of step. It is easy to point the finger at the cost consultants here – but the truth is that all members of the design team are usually to blame. Seeing the whole picture, or caring about the requirements of other disciplines, is disappointingly rare. The inevitable consequence is a design that is underdeveloped and a cost plan that is based on too many assumptions – a model that is firmly rooted in short-term profit.

It is for these reasons that the financial detail will not coordinate with the design, any fit between them being very much a matter of chance. This is, of course, both short-sighted and regrettable. The focus is entirely on money. Using finance as the driver to reach more rational conclusions, but not to derive a solution, as most seem to do, is hardly rational. Confused and irrational, these methods just serve to compound the problem.

This book aims to set out a more rational process, away from the financial issues, and to focus on the practical, physical issues that actually establish the whole life cost of buildings and their components. Logically, delivering a real whole life analysis must surely benefit the project and the client, as well as the reputation of the team. In the long term, this must be the only way forward.

Cost is important, of course, but it must be seen in context of the project as a whole, not as a result of – nor the driver for – whole life costing. All forms of analysis to date use a multitude of assumptions to establish a financial statement. This is then used to establish the whole life potential of a particular course of action. How can this possibly be of any real benefit, or in the least way accurate?

It is better to focus on real-world issues to establish the potential, and then to identify whether this is a cost worth paying, and whether it is affordable or even achievable. All too often, the paper principles may not even be achievable, and this cannot be a sensible way to proceed. We need to take action now – if not, we will be forced into reactive measures in future decades.

First, the logic of what is useful and what is not needs to be determined. There is no point in devoting large amounts of resource to analysing a project for it to be so entirely theoretical as to be meaningless. We should be asking at the start: what is the point, where will this benefit the building, or the client, or the end users? Quality of work and maintenance is crucial to all of this, and without a clear understanding of what is required and what can be delivered, there is no point to the exercise. Ensuring that these factors are controlled and undertaken in accordance with the project plan is fundamental. But currently there are few drivers.

Predicting trends in future materials, fashions and commercial pressures is also a complex area. Without some understanding of these, it is difficult to see how any assessment will be of use.

By looking in detail at all the factors involved, a useful model can be produced that allows a range of outcomes to be identified. This can then be used to determine the specification and building operation procedures to deliver the anticipated outcome.

What are whole life cost and whole life value? What benefits do they have? It is important to at least try to estimate the answers, even if flawed.

Any project requires resources. At the beginning, these include the design team and construction processes. For any client requirement, there are a multitude of solutions