Programming and Scheduling Techniques

Second Edition

Thomas E. Uher and
Adam S. Zantis

Programming and Scheduling Techniques

Second Edition

Thomas E. Uher and
Adam S. Zantis

Spon Press
an imprint of Taylor & Francis
LONDON AND NEW YORK

First edition published 2003
by UNSW Press

This edition published 2011
by Spon Press
2 Park Square, Milton Park, Abingdon, Oxon OX14 4RN

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

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

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
Uher, Thomas E.
Planning and scheduling techniques / Thomas E. Uher and Adam S. Zantis.
p. cm.
Includes bibliographical references and index.
1. Project management. 2. Strategic planning. 3. Production scheduling. I. Zantis, Adam S. II. Title.
T56.8.U38 2011
658.4'04–dc22
2010050588

ISBN: 978-0-415-60168-9 (hbk)
ISBN: 978-0-415-60169-6 (pbk)
ISBN: 978-0-203-83600-2 (ebk)

Typeset in Goudy
by RefineCatch Limited, Bungay, Suffolk

MIX
Paper from responsible sources
FSC
www.fsc.org
FSC® C004839

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

Programming and Scheduling Techniques

Planning is an important management function and its effective execution is crucial to ensure the success of any project. This second edition of Thomas Uher's and Adam Zantis' textbook maintains its focus on operational rather than strategic aspects of programming and scheduling of projects, providing the reader with the practical planning skills needed to be successful.

Unlike most other textbooks that largely focus on the critical path method, *Programming and Scheduling Techniques* includes a comprehensive review of a range of practices used around the world. Topics covered in this thoroughly revised edition include:

- deterministic scheduling techniques including the bar chart, the critical path method, the critical chain method, the multiple activity chart and the line of balance
- a comparison of the critical path and critical chain scheduling techniques
- options for computer-based scheduling
- stochastic scheduling techniques including the critical path method based on Monte Carlo simulation and the Program Evaluation and Review Technique (PERT)
- risk in scheduling
- work study.

By covering a broad range of scheduling techniques this book is suitable for those planning projects in any industry, particularly in interdisciplinary or international contexts.

Learning activities, step-by-step guides, and a downloadable answers booklet make sure no reader is left behind. Written for students studying undergraduate and postgraduate architecture, building, construction/project management, quantity surveying, property development and civil engineering programs.

Thomas E. Uher was an Associate Professor in the Faculty of the Built Environment at the University of New South Wales between 1978 and 2009. He presently works as a consultant on project management, contract administration and partnering, and as an Adjudicator of payment claim disputes under the NSW, Queensland and Victorian Security of Payment Acts. He is author of over 100 journal articles and 3 books.

Adam S. Zantis has been working as a project planner and manager in the construction industry for the past seven years. Adam's expertise in planning and scheduling has been recognised by the University of New South Wales, where he currently lectures.

Abbreviations

ACWP	Actual cost for work performed
AREA	Area/department
AS	Activity slack
BAC	Budget at completion
BCWP	Budget cost for work performed
BCWS	Budget cost for work schedule
CC	Critical chain
CCM	Critical chain management
CCS	Critical chain scheduling
CIM	Control interval and memory
CONS	Construction department
CONT	Contracts department
CPI	Cost performance index
CPM	Critical path method
CV	Cost variance
DEP	Department
EAC	Estimate at completion
EFD	Earliest finish date
EPS	Enterprise project structure
ES	Event slack
ESD	Earliest start date
ESTM	Estimating department
EV	Earned value
FF	Free float
FINC	Financial department
FTS	Finish-to-start
FTF	Finish-to-finish
HRMG	Human resource management department
ID	Identification code
ITEM	Item name
LSD	Latest start date
LFD	Latest finish date

LOB	Line of balance
LOCN	Location
LSM	Linear scheduling method
LSMh	Linear scheduling model
MAC	Multiple activity chart
MAX	Maximum
MBO	Management by objectives
MILE	Milestone
MIN	Minimum
OBS	Oraganisational breakdown structure
PC	Percentage complete
PERT	Program evaluation and review technique
PRCH	Purchasing department
RESP	Responsibility
RPM	Repetitive project modelling
RUF	Resource utilisation factor
SPI	Scheduled performance index
STS	Start-to-start
STF	Start-to-finish
SV	Scheduled variance
TF	Total float
TLS	Tender letting schedule
TOC	Theory of constraints
VPM	Vertical production method
WBS	Work breakdown structure

Preface

Planning is the first functional step in any production process. It requires that every task essential in developing a construction project is identified, and carefully incorporated and integrated into an overall development programme that ensures successful project outcomes. Without an effective plan, there can be no control over the production process.

In any organisation, planning is essential at all management levels. Top managers are concerned with strategic and business planning, while middle and lower managers develop operational plans which formulate specific operational strategies for achieving the objectives set out in the strategic and business plans. This book addresses operational rather than strategic aspects of planning of construction projects. It describes specific scheduling techniques and processes commonly used in the construction industry. While used mainly at the construction stage, the described techniques and processes are suitable for application across all the stages of the project lifecycle.

Many books have been written on aspects of construction scheduling, but they largely focus on the critical path method and do not provide a comprehensive review of a range of scheduling techniques. This book attempts to redress this problem.

While this book serves as a reference for construction industry practitioners, it has mainly been written as a text and reference material for students studying architecture, building, construction management, civil engineering, and for quantity surveying undergraduate and postgraduate programmes.

The second edition of this book benefits from having Adam Zantis as second author. Adam has injected into this new edition his practical knowledge of applying various scheduling techniques in the construction industry. This is reflected in inclusion of status reporting in Chapter 6, *Project control*, the substantial revision of the material in Chapter 7, *Critical path scheduling by computer*, a revision of the material in Chapter 8, *Critical chain scheduling*, and inclusion of the new material on productivity rate databases in Chapter 11, *Work study*, and on risk contingency calculations in Chapter 12, *Risk and scheduling*.

The format of the book remains much the same with the previously discussed scheduling techniques retained. However, the content of some chapters has been

either revised or updated and, where appropriate, expanded. Scheduling techniques described in the book include the bar chart, critical path method, critical chain scheduling, multiple activity chart and line of balance. Although not strictly a scheduling technique, work study has nevertheless been retained since it assists planners and project managers in developing efficient production methods.

T. E. Uher
A. S. Zantis

Contents

Tables

Figures