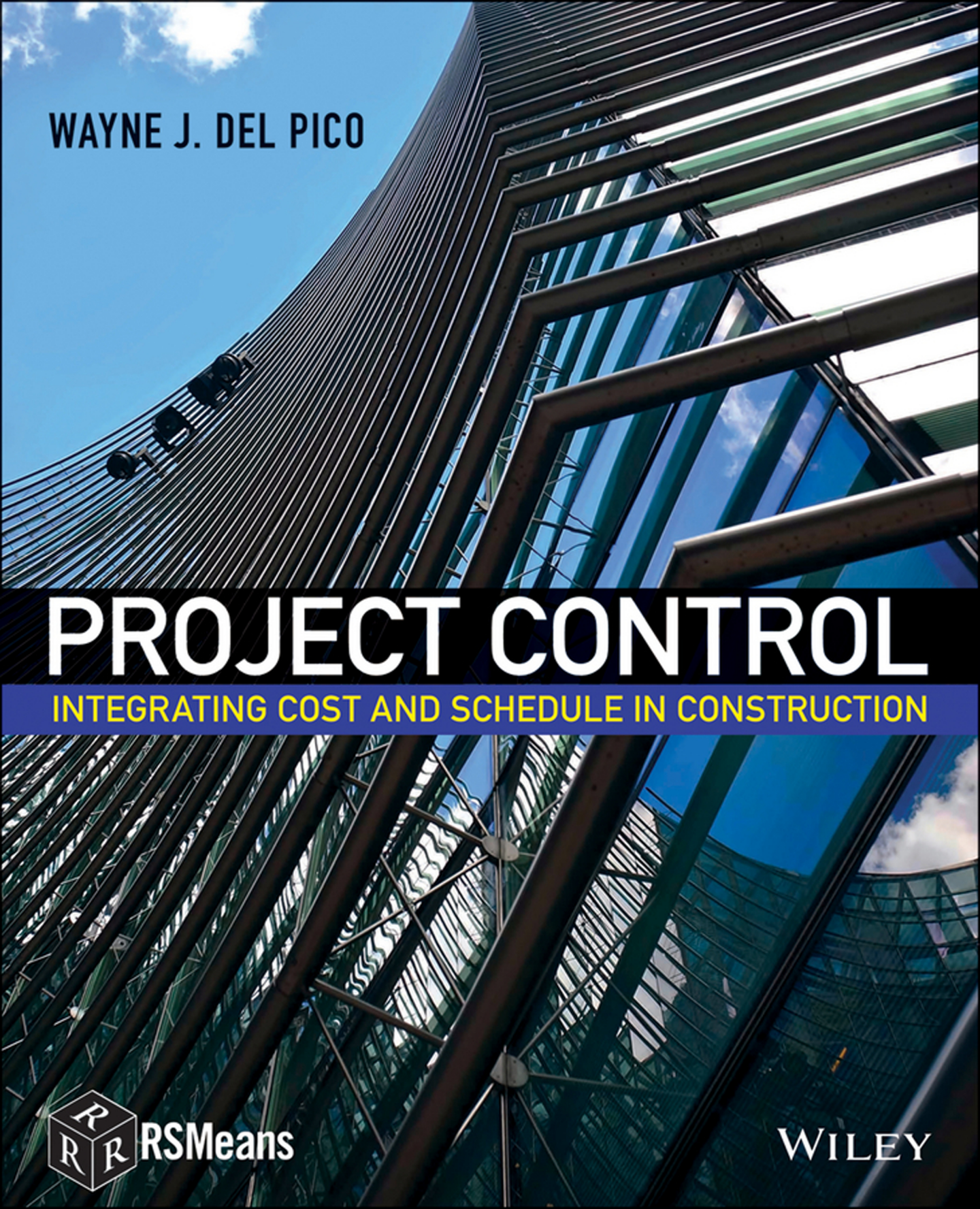




WAYNE J. DEL PICO

PROJECT CONTROL

INTEGRATING COST AND SCHEDULE IN CONSTRUCTION



WILEY

Project Control

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Integrating Cost and Schedule in Construction

Wayne J. Del Pico, CPE



WILEY

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Published by John Wiley & Sons, Inc., Hoboken, New Jersey
Published simultaneously in Canada

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Library of Congress Cataloging-in-Publication Data:

Del Pico, Wayne J.

Project control : integrating cost and schedule in construction / Wayne J. Del Pico, CPE.
pages cm

Includes bibliographical references and index.

ISBN 978-1-118-13923-3 (cloth : acid-free paper), ISBN 978-1-118-41913-7 (ebk.);
ISBN 978-1-118-42106-2 (ebk.); ISBN 978-1-118-80271-7 (ebk.) 1. Construction projects—
Management. 2. Building—Estimates. 3. Scheduling. I. Title.

TH438.D448 2013
624.068'4—dc23

2013001240

Printed in the United States of America

10 9 8 7 6 5 4 3 2 1

Dedication
Arman J. Del Pico
1921–2011

*To my father, who taught me by quiet example the meaning of living a life
based on a personal code of values and strength of character.*

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Foreword

Successful projects do not happen by accident. Far too often, construction projects fail due to a lack of proper management. In today's competitive market, diligent management is essential not only to deliver an individual project, but also to stay in business. In this book, the author analyzes the concept of project control and how it is critical to achieve project success.

Managing the schedule can help manage costs. Projects frequently fail because contractors focus on cost or schedule, not both simultaneously. We all have heard the phrase "time is money." This truth cannot be overstated. *Project Control* explains how schedule and budget are integrated and how both can be effectively managed. In a systematic, easy-to-understand format, the author discusses how to anticipate, prepare for, and resolve the inevitable road bumps that commonly occur on construction projects large and small.

A key component that is stressed throughout the text is planning. Sounds simple, right? It's not. Planning requires due diligence not only at the beginning of a project; it is an essential activity that continues through project closeout. Developing and updating a CPM schedule, monitoring cash flow, allocating resources, and anticipating risks are just some of the factors of planning that are discussed within this text. Those of us in the industry that have witnessed projects that fall behind schedule or exceed budget can attest that lack of planning is typically the root cause.

For a myriad of reasons, construction projects often do deviate from the initial schedule and/or budget. *Project Control* examines the details behind how performance is measured and tracked and provides the tools to analyze a project at any phase. By creating a detailed budget and CPM schedule and regularly monitoring performance in relation to these items, a project manager can identify and evaluate causes of significant deviation and take corrective action to keep the project on time and on budget. Of equal importance, *Project Control* teaches the reader not only how to identify and analyze problems, but also how to anticipate them.

What actions should be taken if a project is underperforming? Obviously that depends on the nature of the project, the cause of the deviation, the budget, the schedule, and risk factors associated with any potential solution. *Project Control* provides an in-depth look at these items and offers sound, practical advice for determining and evaluating potential solutions.

Many books have been written about project management, but none that I have read have been tailored so seamlessly to the construction industry. The author's systematic approach to analyzing the factors required to achieve proper project control is both thorough and enlightening. Whether you are a general contractor or subcontractor; an industry veteran or just beginning your career; the concepts discussed in *Project Control* will help you achieve success.

David M Sorgman
Vice President of Architectural Services
Group 7 Design, Inc.

About the Author

Wayne J. Del Pico is President of W.J. Del Pico, Inc., where he provides construction management and litigation support services for construction-related matters. He has more than 33 years of experience in construction project management and estimating and has been involved in projects throughout most of the United States. His professional experience includes private commercial construction, public construction, retail construction, and residential land development and construction.

Mr. Del Pico holds a degree in civil engineering from Northeastern University in Boston, where he taught construction-related curriculums in Cost Estimating, Project Management, and Project Scheduling from 1992 until 2006. He is also a member of the adjunct faculty at Wentworth Institute of Technology in Boston, where he presently teaches programs in Construction Cost Analysis, Estimating, Project Control, and Construction Scheduling.

Mr. Del Pico is a seminar presenter for the R.S. Means Company, where he lectures on topics from estimating to scheduling. He is the author of *Plan Reading and Material Takeoff* (1994) and *Estimating Building Costs* (2004 and 2012), and is a coauthor of *The Practice of Cost Segregation Analysis* (2005).

His construction experience and knowledge of the industry qualified him to be the president of the Builders Association of Greater Boston in 2010. He is also a practicing third-party neutral for the American Arbitration Association where he hears construction-related arbitration cases.

Introduction

At the upper level of the project management process is project control. It can be part of the day-to-day responsibilities of the project manager, or it can be under the jurisdiction of the more specialized project analyst. Project control combines the management skills of the project manager with the analytical focus of the professional accountant.

The construction industry has always been cost and schedule conscious; however, in lean economic times, that consciousness becomes a mantra. In today's commercial construction market, adhering to a schedule and maintaining a delivery date often define the difference between success and failure. Contracts carry substantial penalties for performance failures in the form of liquidated damages as well as the actual and consequential damages that may result from the delay. Getting to the finish line on time is critical. No less critical for the contractor is controlling costs in the process. What benefit is it if the project is delivered on time, but its costs exceed the stipulated sum of the contract and plunge the contractor into financial chaos?

The mainstream use of computers in the construction process has been a tremendous boon to the industry; at the same time, it has added a layer of complexity to the management process. The data is collected, collated, updated, filtered, and finally released for the project manager to analyze and interpret. The resulting information, subjective as it may be, is driving the decision process, leaving the manager with little doubt as to the appropriate real time status of the work from a cost and schedule perspective. With the correct and timely information, decisions can be made and actions implemented.

Productivity studies have proven that human performance and its corresponding labor costs have always been the wild card in the construction process. In comparison, material costs are more easily definable and to a large degree finite. Accurate estimating procedures and recognized professional standards help to pinpoint material quantity and cost. This is not so with labor. Despite standardized procedures for most tasks and a bounty of data on production rates, small errors can force labor costs to run amok. Labor requires the lion's share of management time to estimate, schedule, monitor, and control. Productivity for even the simplest task can be affected by a plethora of variables from crew size to weather.

Productivity models, once created for an individual project, must be monitored and controlled, and deviations from those models require corrective actions.

For projects that extend over multiple years, the concept of project control becomes even more of a concern. Costly projects with labor-intensive tasks such as process piping or electrical distribution lines must be monitored to ensure adherence to the estimated productivity rates. With these types of tasks, a small decrease in productivity can become chronic over time and put a project in the red quickly.

The key to successful project control is the fusing of cost to schedule whereby the management of one helps to manage the other. This requires that a task's cost and its duration have a direct relationship, and not be just the scheduler's arbitrary assignment. Ensuring that relationship is correct and setting the appropriate baseline for tracking is the domain of the project control expert.

Accurate project control also serves as the basis of historical cost data for fine-tuning estimated productivity on future projects.

This book will explore the reasons behind and the methodologies for proper planning, monitoring, and controlling both project costs and schedule. It will take a fresh, simplified look at the topic of project control as it is applied in the construction industry today.

Chapters 1—The Basics explains project management theory and a brief history of the science. It discusses the different approaches to project management and the five processes within the Traditional Approach. It reviews the roles and goals of the project manager in the construction industry today. It defines the role of the contract documents in the controls process. Lastly, the relationship between the schedule and the budget is explored.

Chapter 2—Introduction to Project Control presents an overview of project control and the role of schedule and cost. It defines the terminology behind the process with formulas common to the control process and the project control cycle.

Chapter 3—Pre-Construction Planning elaborates on the importance of proper planning in the preconstruction phase. It provides a window to the key personnel and their responsibilities in the cycle. This chapter outlines the importance of communication and setting baselines for performance measurement.

Chapter 4—The Schedule is a review of basic scheduling types and methods, with a detailed review of the critical path method. It explains the use of the CPM as a management tool.

Chapter 5—The Budget highlights the cost side of the controls process and the fundamentals of going from estimate to budget. This chapter discusses the specifications and the organizational structure of the budget. It reviews the creation of the cost breakdown structure and its relationship to the schedule.

Chapter 6—Integrating the Schedule and the Budget provides detail on how both of these come together to create the full view of project control. It provides a brief introduction into developing the Schedule of Values.

Chapter 7—Calculating and Analyzing Progress explores how performance is measured, and expands on the concept of Earned Value Management for both fixed and variable budgets. It explains the schedule and cost performance measurements and indicators so crucial to determining project status.

Chapter 8—Analyzing and Reporting Variances in Schedule and Cost provides a look at how to interpret and display project data through common tools such as the S-curve and root cause analysis, and how the data can be reported for use.

Chapter 9—Recognizing Trends and Forecasting Performance explains how the measurements and the derived data can be used to recognize emerging trends and how the same data can be used to forecast future performance. It also explains key indicator values for predicting final performance.

Chapter 10—Productivity defines productivity and why it is so important for accurate project control. It defines factors, both controllable and uncontrollable, that can affect productivity.

Chapter 11—Acceleration and Schedule Compression outlines the different types of acceleration, including why and how they are used. It also considers schedule compression and what can be expected. Finally, it looks at time-cost trade-off analysis and what it means in terms of task performance.

Chapter 12—Resource Management develops the concept of resources and how they can impact a project. Resource and material management is introduced as a practical method for control.

Chapter 13—Risk Management considers the different types of risk a project will be exposed to and how risk can be managed. It also explains how risk is funded, and how its probability is determined.

Chapter 14—Project Closeout discusses how projects are wrapped up and the importance of sharing what has been learned, both good and bad.

Accurate construction project control is an essential skill of every successful project manager. *Project Control-Integrating Cost and Schedule in Construction* builds on the foundation of project management principles for the extra level of professional control so many projects are in need of.

—Wayne J. Del Pico, July 2013

CHAPTER 1

THE BASICS

Even for the most seasoned professional with years of construction project management experience, it is still beneficial to revisit the basics once in a while if for no other reason than to “re-enforce” what we already know. This chapter provides an overview of project management theory and where project control fits into the discipline. It does not offer detailed instruction in the profession of day-to-day project management, but will review the theory of project management and the basic concepts common to the construction industry.

The Concept of Project Management

Project management is the professional discipline of planning, monitoring, and controlling specific resources to achieve a set of goals for a project. The term *project* is defined as a one-time endeavor with well-defined, often unique goals, with specific limits of both time and cost. The temporary nature of a project is in contrast to businesses like manufacturing that are repetitive in nature. This type of management has predefined systems or processes that have been refined over time. The management of a project, in contrast to manufacturing, requires a different paradigm and skill set on the part of the practitioner. The project manager’s main test is to achieve all of the goals, including the deliverables, within the constraint of a fixed budget and fixed time frame. Specific goals and deliverables in the construction industry will vary from project to project.

For the purpose of this text, let’s refine the definition to reflect a project as defined by the construction industry. Project management in the construction industry is the professional practice of planning, scheduling, monitoring, and controlling a finite amount of resources—materials, labor, equipment, and subcontractors—to achieve a set of goals, which are usually a series of engineering improvements for a unique one-time event, the project. To compound this definition, planning, scheduling, monitoring, and controlling must occur within a defined duration and a frequently fixed budget. To further complicate the process, let’s add some unpredictable factors such as weather, labor strikes, material shortages, and a wide range of separate goals and conflicting agendas proposed by the participants. Lastly, let’s not forget the ever-present threat of financial penalty as a “reward” for failing to master all of the above challenges!

History of Project Management

The concept of project management is not new. It has been practiced since human beings noticed the need for improvement in their surroundings. There is a near 100 percent chance that the construction of the Great Pyramids of Giza had a project manager or multiple project managers over time. Rather than bore the reader with recounting the development of project management since the dawn of the Bronze Age, let's consider what's important.

As a professional discipline, project management emerged as construction projects became more complex and warranted an individual to be accountable for the performance and results. Techniques for managing projects started to develop at the dawn of the twentieth century.

Much of the credit for the development of project management techniques can be given to two early pioneers: Henry L. Gantt and Henri Fayol. Both Gantt and Fayol were students of Frederick Winslow Taylor's theories of scientific management.

Henry L. Gantt (1861–1919) was an American mechanical engineer who later became a management consultant to the steel industry. He worked with Taylor until 1893, applying scientific management principles to the production of steel. Gantt is called the father of planning and control techniques in project management. He is most recognized for the development of a visual management tool that displays a task as a function of time. It is used to measure actual progress against planned progress. The tool was aptly named the *Gantt chart* and is still very much in use today.

Gantt's 1919 book *Organizing for Work* describes two principles of the Gantt chart:

- Measuring activities by the amount of time needed to complete them (task duration)
- Representing the quantity of the task that should have been done in that time (daily output)

Gantt was one of the first to recognize that in order for a team of workers to produce efficiently and to maintainable standards, the team needed an intelligent leader that could solve or preempt problems.

Henri Fayol (1841–1925) was a French mining engineer who developed a general theory of business administration later referred to as *Fayolism*. Fayol believed in analyzing the role of management to reduce problems and to increase worker efficiency. Fayol is credited with the creation of the six management functions that are still the basis of project management today;

- Forecasting
- Planning