

Profitability Accounting and Bidding Strategy for Engineering and Construction Management

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VAN NOSTRAND REINHOLD COMPANY

NEW YORK CINCINNATI TORONTO LONDON MELBOURNE

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Library of Congress Catalog Card Number: 82-23687

ISBN: 0-442-26005-9

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Manufactured in the United States of America

Published by Van Nostrand Reinhold Company Inc.
135 West 50th Street, New York, N.Y. 10020

Van Nostrand Reinhold
480 Latrobe Street
Melbourne, Victoria 3000, Australia

Van Nostrand Reinhold Company Limited
Molly Millars Lane
Wokingham, Berkshire, England

15 14 13 12 11 10 9 8 7 6 5 4 3 2 1

Library of Congress Cataloging in Publication Data

Lang, Hans J.

Profitability accounting and bidding strategy for engineering
and construction management.

Includes index.

1. Construction industry—Accounting. I. DeCoursey,
Michael. II. Title.

HF5686.B7L33 1983 657'.869 82-23687
ISBN 0-442-26005-9

PREFACE

This book is written for people engaged in the engineering and construction industry and primarily business development and sales personnel, project managers, project engineers, proposal managers, estimators, cost engineers, planners, schedulers, project accountants, construction managers, and last but by no means least, departmental and general managers.

The engineering and construction industry is project oriented. The projects with which it deals frequently span several years. Even those spanning less than a year usually impact more than one financial period. Therefore, a set of accounting principles and procedures has been developed to systematize profit taking on ongoing projects for which the profit finally earned will not be known for months or years ahead.

How such financial entries are handled and how the information which supports them is gathered is not covered in any book or publication of which we are aware. In the engineering and construction companies themselves this body of knowledge is usually known only to the financial departments. It is seldom, if ever, understood by personnel engaged in implementing projects. Generally, and in our opinion unfortunately, it is also little known to general and departmental managers.

In our book we cover the accounting techniques which managers and project staff members need to understand profit taking. The intent of the book is not to make those who read it expert accountants. It is rather:

- To help them understand how financial and accounting people derive the profit entries on which financial statements are based, and

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- To realize how their performance impacts on financial performance.

Knowledge of profit taking is also important—or should be—to those who have the responsibility for recommending and deciding which projects to bid. Timing is of the essence in profit taking. It may be more important for a company's profit performance for the current fiscal year to bid projects on which profits can be earned rapidly even though there are other projects which might have a more favorable outcome.

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ACKNOWLEDGMENT

Our appreciation and thanks to Karen Williamson, the Manager of our Corporate Communications Department, for the time and effort, and for the tender loving care she applied to the preparation of our manuscript.

**H. J. Lang
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The Pritchard Corporation**

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Part I

Financial Accounting

1. Introduction

THE ENGINEERING AND CONSTRUCTION INDUSTRY

The engineering and construction industry performs two major functions:

- Design
- Construction

The principal output or products of the design function are specifications and drawings. The specifications are used to procure the equipment and material which are needed to build the facilities described by the drawings. The principal output of the construction function is, of course, the erection of the facilities in accordance with the specifications and drawings prepared by the design function.

The design function is carried out by engineers, designers, and draftsmen. The construction function is carried out by construction laborers—carpenters, cement finishers, welders, pipe fitters, electricians, and many other craftsmen.

Both functions are supervised by a management and support staff which includes general managers, financial managers, engineering managers, project managers, construction managers, estimators, schedulers, accountants, purchasers, expeditors, and inspectors.

The management and support personnel concern themselves with three major objectives:

- Quality
- Schedule
- Cost

Quality refers to both design and construction. The design must meet well-known and established standards, not only for quality but also for safety and environmental impact. The construction must be done in accordance with equally well-known and established standards, with proper safety provisions, and with due consideration to the impact the carrying out of the construction work will have on the environment.

Schedule refers to planning and scheduling for completion of projects within acceptable time frames.

Cost refers to budgets and controls for carrying out projects within the funds allotted to, and available for, their execution.

The construction industry is a major one. Its output represents about ten percent of our gross national product, which is currently at an annual level of three trillion dollars. It employs, directly and indirectly, on the order of ten million people.

Much of what we say below also applies to the engineering and construction industry outside the United States. Great Britain, Germany, France, Italy, and Japan are all major international competitors for both engineering and construction. Many other nations—India, Korea, the Philippines, Poland, Thailand, and Yugoslavia, to cite a few—are major competitors for construction. Exports of construction labor contribute significantly to the foreign exchange earnings of these countries.

MAJOR FACILITIES

Our concern in this book is that section of the engineering and construction industry engaged in the design and construction of major facilities. This term refers to multimillion and, in some instances, multibillion dollar projects designed and built by firms whose names are a byword in the engineering and construction industry—Bechtel, Braun, Fluor, Foster-Wheeler, Lummus, Pritchard, Procon, and many others.

Major facilities fall into three groups:

- Heavy construction
- Buildings
- Plants

Heavy construction refers to highways, bridges, tunnels, dams, subways, and other large projects which are for the most part built for the public sector.

Buildings in the context of “major facilities” refers to office buildings, hotels, hospitals, and other large commercial and institutional buildings and complexes.

Plants refers to three types of facilities, each having distinctive characteristics:

- Industrial plants
- Process plants
- Power plants

Industrial plants vary in their complexity and size. At one extreme there are steel mills and automobile assembly plants. At the other, there are canneries, bottling plants, toy factories, and other small manufacturing installations. The distinctive characteristics we associate with industrial plants are that they are usually housed, that the processes carried out are mostly mechanical in nature, and that the materials handled are most often in the solid state.

Process plants also vary widely, from large catalytic cracking plants and heavy water distillation plants at one extreme, to small sulfur recovery and environmental cleanup units at the other. Their distinctive characteristics are that the plants are predominantly outdoors, that the processes carried out are chemical in nature, and that the materials handled are most frequently in the gas and liquid phases.

Power plants vary from multibillion dollar central station units built by public utilities to smaller industrial installations built by industries to serve their needs at particular locations. Power plants share the characteristics of both industrial and process plants.

In sum, these three categories—heavy construction, buildings, and plants—represent about one third of the total construction market. Another third is represented by residential construction. The remaining third is a catchall for large and small projects that do not fit into any of the above categories. Examples are pipelines, electric transmission lines, shopping centers, parking lots, and the numerous small projects handled by local contracting firms.

CHARACTERISTICS OF THE INDUSTRY

The engineering and construction industry is a project-oriented industry, as distinguished from a product and service-oriented industry. Its output, as we have mentioned, is bridges, roads, process plants, and office buildings rather than automobiles, tractors, cans of tomato soup, bars of soap, and tubes of toothpaste.

In what follows, we describe some of the characteristics of this industry. The emphasis throughout this book is on that sector of the industry engaged in the design and construction of major facilities.

Some of the firms in the engineering and construction industry do design only, some do construction only, and some do both engineering and construction.

For heavy construction projects and for commercial and institutional buildings, the design function is generally handled by one firm and the construction function by another. This is also quite common for industrial plants and power plants. The contrary is true with process plants. For these, it is customary to handle projects on a turnkey basis. This means that the design and construction for any given project is the responsibility of one firm.

The term *turnkey* stems from the housing industry in which the buyer assumes that, when his residence is finished, he will be handed a key with which he can open the front door and walk into a finished residence. It does not quite work that way with process plants and with industrial and power plant installations, but the phrase is, nevertheless, an apt one and is used quite frequently to signify total “single point” responsibility.

Another term which is used quite often and which is analogous to turnkey is *EPC*. These letters stand for Engineering, Procurement, and Construction. An EPC contract is one in which the contractor does the design, procures the equipment and material needed for construction, and constructs the plant with his own forces, with subcontractors, or more commonly, with a combination of both.

Other differences in the handling of construction among the three types of major facilities identified above are:

- In heavy construction, the contractor awarded the work usually does most of it with his own forces, that is, with his own construction equipment and direct hire labor.

- In commercial and institutional buildings, the contractor subcontracts most, if not all, of the work to specialty subcontractors for piling, foundations, structural steel erection, heating, ventilation, air conditioning, electrical installations, insulation, painting, and all the other specialties that enter into building construction work. His role is that of a general manager.
- In plant work, and particularly process plant work, a combination of the two is most frequently used. Most clients prefer process plant contractors to do work such as piping and equipment installations themselves, that is, to direct hire rather than subcontract. The electrical and instrumentation work is often subcontracted. Insulation and painting almost always are.

CONTRACTUAL ARRANGEMENTS

Engineering and construction contracts fall into two major categories:

- Reimbursable
- Fixed price (also called lump sum).

Within these extremes, there are numerous variations.

Design-only contracts can be reimbursable with a percentage fee to cover profit, or reimbursable with a fixed fee to cover profit, or fixed price, or guaranteed maximum. Under the latter, the contract is reimbursable until a guaranteed maximum figure is reached. At that time, all remaining costs are for the engineering firm's account.

Construction-only contracts show similar variations—reimbursable, reimbursable except for construction supervision and construction equipment which are fixed, guaranteed maximum, or fixed price. Unit price contracts are also used. Under these, there is a schedule of prices for performing each of the elements that enter into construction. Examples are unit prices for pouring a cubic yard of concrete or erecting a ton of steel or installing so many feet of pipe. Unit price contracting has been highly refined by international contractors. Under this type of contract, clients enter into an arrangement with consulting firms specializing in quantity surveying for verifying and reporting the amount of work completed at any given time.

Contracts covering both design and construction, that is, turnkey