



MEASURING THE COST OF QUALITY IN DESIGN AND CONSTRUCTION

Bureau of Engineering Research
The University of Texas at Austin

Publication 10-2
May 1989

The purpose of this publication is to make available to industry the results of research conducted by the Construction Industry Institute (CII). The publication does not necessarily represent the views of all CII member companies, but is offered as a contribution to the industry.

CII was founded in 1983 to improve the cost effectiveness of the nation's largest industry. The members, who represent a broad cross-section of owners and contractors, believe that many of the problems that limit cost effectiveness are common ones, and that real improvements can be best accomplished in a cooperative environment with the benefits being shared by the construction industry at large.

The activities of CII include identifying research needs, conducting research, and aiding implementation of research results. The task forces that provide guidance for specific CII activities are listed below.

- 83-4 Industry Data and Statistics
- 84-10 Quality Management
- 85-11 Employee Effectiveness
- 85-12 Project Organization
- 85-13 Safety
- 85-14 Education and Training
- 87-15 Technology Survey
- 87-16 Advanced Technological Systems
- 87-17 Construction 2000
- 87-18 Partnering
- 87-19 Insurance
- 87-20 Electronic Data Management
- 87-21 Project Team Risk/Reward Allocation
- 87-22 U.S. Navy Demonstration Project
- 87-23 Claims
- 88-24 Contracting, Phase II
- 88-25 Computer Integrated Design & Construction
- 88-26 Retrofit Projects
- 88-27 Change Order Impacts
- 88-28 Construction Work Force
- 88-29 Modularization
- 88-30 International Construction

The Construction Industry Institute
The University of Texas at Austin
3208 Red River
Suite 300
Austin, Texas 78705-2650
(512) 471-4319

**Measuring the
Cost of Quality
in Design and Construction**

**Prepared by
The Construction Industry Institute
Quality Management Task Force**

**Publication 10-2
May 1989**

© 1989 Construction Industry Institute™.

The University of Texas at Austin.

CII members may reproduce and distribute this work internally in any medium at no cost to internal recipients. CII members are permitted to revise and adapt this work for the internal use provided an informational copy is furnished to CII.

Available to non-members by purchase; however, no copies may be made or distributed and no modifications made without prior written permission from CII. Contact CII at <http://construction-institute.org/catalog.htm> to purchase copies. Volume discounts may be available.

All CII members, current students, and faculty at a college or university are eligible to purchase CII products at member prices. Faculty and students at a college or university may reproduce and distribute this work without modification for educational use.

Printed in the United States of America.

TABLE OF CONTENTS

<i>Chapter</i>	<i>Page</i>
Summary	v
1. Introduction	1
2. The Cost of Quality	3
Definitions	3
Concepts	3
3. The Quality Performance Management System (QPMS)	5
Information Tracking	5
Deviation Correction Costs	5
Quality Management Costs	7
Work Discipline Categories	8
4. QPMS Data Collection and Analysis	9
5. Conclusions	11
References	13

SUMMARY

Failure to maintain quality costs the U.S. construction industry over \$15 billion a year in rework expenses alone. Additional costs for other quality failures may bring the total to more than twice that amount.

Quality must be properly managed if complex industrial projects are to be completed and operated economically. How is quality managed? By controlling the *costs* of quality.

Defining quality in the limited and specific sense of *conformance to established requirements* enables the cost of quality to be measured and quantified. The goal is to minimize the cost of quality and to maximize the return on investment. Quality costs include the costs of quality management (prevention and appraisal costs) and the costs of correcting deviations. Benefits are achieved through a reduction in the *costs* of quality.

The Construction Industry Institute (CII) Quality Management Task Force has developed a Quality Performance Management System (QPMS) which costs little to implement. The QPMS is based on the premise that quality costs can be adequately tracked using 11 rework causes and 15 quality management activities. When categorized according to a small number of major disciplines (civil, electrical, etc.) and the major project phases (design, procurement, construction, and start-up), the resulting system is simple, flexible, cost-effective, and easily understood. The QPMS is a powerful tool for project management in terms of identifying quality issues and their impact costs, and in determining how to correct them in order to reduce project costs.

As with any tool, the QPMS requires the understanding, attention, and insight of management before it can yield the user any direct reduced costs. The QPMS allows management to place primary emphasis on those areas of greatest significance, and to understand those areas that have little or no cost consequence. Cost-tracking codes can be assigned to quality management activities and deviation rework categories, and also can be easily integrated into existing cost breakdown structure accounting systems.

The QPMS is being field-tested on eight projects. Evaluation based on early feedback indicates that the QPMS captures useful quality cost information in terms of project tasks, including quality management activities and deviation categories.

Using this streamlined, simple QPMS to track and analyze the cost of quality will boost the cost effectiveness of the construction industry on both current and future projects.

INTRODUCTION

The U.S. construction industry is ill. Productivity has declined significantly in the past two decades. Delays in construction are common and expensive, and litigation related to design and construction continues to increase.

The situation is neither new nor surprising to the industry. The Business Roundtable's 1983 Construction Industry Cost Effectiveness (CICE) report (Reference 1) summarizes the situation:

"By common consensus and every available measure, the United States no longer gets its money's worth in construction, the nation's largest industry."

One significant cause for this poor performance is the use of inadequate and outmoded management practices. Although the complexity and uniqueness of construction make adopting modern management techniques difficult, improvement is possible. In many cases the management tools available are simply not used, while in other cases the appropriate management tools have not been developed. Certainly, performance and cost effectiveness can be significantly improved through the use of better management techniques and tools.

One of the fundamental duties of management is to assure that products meet requirements. As the CICE report concludes, the industry needs to understand and use quality assurance/quality control (QA/QC) programs in the planning, designing, and constructing phases of many engineered projects.

The term "quality" here is used in a limited and specific sense. In that sense, quality is a bottom line issue. Quality means *conformance to established requirements*, and as such is quantifiable.

Research results from a study of nine industrial projects, with individual project costs up to \$900 million, show that rework alone represents an average of 12 percent of the total installed costs (see Reference 2). Documented losses of 12 percent in U.S. industrial construction translate to over \$15 billion wasted each year.

The 12 percent rework cost is only the tip of the iceberg for the cost of quality. Other quality costs are for quality management; for rework during design or rework by vendors and subcontractors; and for impact costs (delays, litigation, loss of productivity) on projects either under construction or during the operation of the facilities. These costs are in addition to the 12 percent that direct rework costs represent. The total cost of quality in U.S. construction, therefore, is probably in the range of 20 to 30 percent of project-installed costs.