An Assessment of the Impact of CII

Construction Industry Institute

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AlliedSignal Inc.
Aluminum Company of America
Amoco Corporation
Anheuser-Busch Companies, Inc.
Aramco Services Company
Atlantic Richfield Company
Bayer Corporation
Celanese
Champion International Corporation
Chevron Corporation
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NASA
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Kiewit Construction Group, Inc.
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North Bros., Inc.
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Raytheon Engineers & Constructors
S&B Engineers and Constructors Ltd.
Stone & Webster Engineering Corporation
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by
Robert F. Jortberg

August 1998

Printed in the United States of America.

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Foreword

This assessment reflects the efforts of the CII staff and others within CII member companies. I would like to express my appreciation for the special efforts of my associates in producing the information upon which this assessment is based.

It is important to recognize that this publication merely records the results of the work of the many CII volunteers who have contributed to the research, implementation, education, benchmarking, and process industries practices programs. Their effort has created the record. This record of improvement must be recognized, as well, to be the result of the vision and leadership of the founding Director of CII, Dr. Richard L. Tucker.

This assessment, while impressive, is really only the beginning. Major opportunities to improve the construction industry remain, and I believe CII can be the leader in achieving future progress.

Robert F. Jortberg
August 1998

1

Overview of CII

The Construction Industry Institute (CII) was established in October 1983 with the purpose of improving the competitive position of U.S. business in the global market. The 28 charter members were responding to the recommendations from a study by The Business Roundtable entitled the Construction Industry Cost Effectiveness (CICE) Project. That five-year study of the industry and its problems specifically recommended that an organization be created to take a leadership role in construction research. The CICE participants included more than 250 industry leaders, practitioners, and academicians. They recognized this particular recommendation as an opportunity for companies and academia to work together for the improvement of the industry.

Since its establishment at The University of Texas at Austin in 1983, CII has pursued a research agenda defined by its Board of Advisors, which is comprised of one representative and an alternate from each member company. Volunteers from the member companies are the core of the effort by CII in all of its activities. Since its start, CII has been supported by a per member average of 17 persons as volunteers.

CII was conceived as a three-way partnership among owners, contractors, and academia. This partnership was based on the premise that each party would contribute from its experience and competence to the overall work of the Institute. The academic community could play a major role in CII by bringing its knowledge of the research process and by providing a credible, neutral voice in the CII process. For practical experience, owners and contractors would provide the knowledge that comes from first-hand and in-the-field experience. The three together would form an owner-contractor-academia triad that would lend itself to world class research that could be applied immediately.

By 1987, however, CII recognized that the completion of research by itself would not achieve its mission of improving industry cost effectiveness. Member companies learned that the integration of the results of this research into the way companies performed their projects would be necessary. CII then began efforts to support implementation of research results both within member companies and within the industry at large. Implementation would have to be done by the companies, and CII would provide helpful support. CII implementation support activities have included workshops, a speakers bureau, the establishment of implementation teams to address special needs such as the application of the research to small projects, and the Construction Project Improvement (CPI) Conference. The CII Annual Conference has been recognized from its beginning as an implementation support medium.

In 1988, CII began efforts to establish a structured education program to assist in the implementation effort. The concept of a three-tiered education program evolved: in-house programs by companies, university-level short courses, and educational programs in support of the Local User Councils of The Business Roundtable and similar organizations. The concept included the preparation of educational modules covering selected CII research. The modules were designed for the short course program, for in-house use, and as a resource for other forms of workshops or seminars. The short course program has been geographically distributed with offerings at The University of Texas at Austin, Clemson University, and Arizona State University.

The next major development in the CII program was Benchmarking and Metrics, initiated in 1994. This effort was instituted to demonstrate the value to the industry of putting the results of CII research into practice. The concept was to identify industry trends and norms and to develop data that would permit a member of the program to compare its performance to industry norms and the "best in class." Another major element of this effort was to measure the impact of the implementation of the best practices identified through CII research.

As a separate initiative, the Process Industry Practices (PIP) program was begun under the CII umbrella. In this program, a number of members and some nonmembers have separately funded an effort to harmonize a number of process industry standard practices. This program does not address society standards such as those of the American Society of Mechanical Engineers (ASME), but focuses on the standards established by the individual companies for their projects. Substantial cost savings are anticipated from this program.

The CII mission has evolved. The mission now is: "To improve the safety, quality, schedule, and cost effectiveness of the capital investment process through research and implementation support for the purpose of providing a competitive advantage to its members in the global marketplace." This mission recognizes that project success is a function of these several parameters, not just cost effectiveness.

The CII membership has grown steadily from its initial 22 members to the current total of over 80 members. A total of 153 companies or organizations have been members of CII during the past 15 years. The balance has remained approximately equal between owners and contractors. The membership has included companies from all industry sectors with the exception of residential housing construction. The heavy industrial sector has had a greater representation in the membership than has light industrial/general buildings and infrastructure, with members from the petrochemical, oil and gas, chemical, power, and pulp and paper industries being involved. One consequence is that more of the projects used as resources in CII research have come from the heavy industrial sector. Although there is some potential for the results of the research to be biased toward that sector, a recent examination has determined that approximately two-thirds of all CII products are relevant to all three sectors—heavy industrial, light industrial/general buildings, and infrastructure.

In 1996, CII recognized the vital role of major suppliers to the project process and invited a limited number of supplier members to become members. At this time, there are three such members with an expectation that several more will ultimately become members.

CII has involved 34 universities, has completed 131 research studies, and has produced 245 publications. These reports have identified 36 best practices and tools. In addition, a total of 21 education modules have been prepared.

From the beginning, the leadership of CII desired to establish and maintain liaison with others having common interests. Several liaison councils have been established providing linkages to The Business Roundtable, contractor associations, professional societies, other research centers, and construction supplier associations. In addition, in recognition of the vital role that the universities play in the construction industry, CII established an Academic Council to maintain a strong linkage with the academic community.

Over time and with experience, it became apparent that one-on-one relationships would, in many cases, be more effective than the liaison councils. Alliances have been established with the Associated Builders and Contractors (ABC), the Mechanical Contractors Association of America (MCAA), the Construction Forum of the American Bar Association (ABA), The European Construction Institute, jointly with The Business Roundtable and the Engineering and Construction Conference of the American Association of Chemical Engineers, and with the Project Management Institute. In addition, CII staff members have maintained relationships with the Federal Facilities Council of the National Research Council (NRC) and the Civil Engineering Research Foundation (CERF).

The purpose of this publication is to quantitatively assess the impact of CII on the industry during the past 15 years and to assist the leadership of CII in planning for the future. Has CII accomplished its mission? What have been its strengths? What have been its weaknesses?

Several aspects of the CII operation have been briefly summarized in this introduction, and their impact on CII members' project performance and on the industry at large will be assessed in the following sections. It is recognized that much of the quantitative data is likely understated because of the difficulty in gathering information from this diverse industry. This assessment is a snapshot; CII activities continue to grow. The following areas will be assessed:

- Impact on project performance
- What has caused this improvement?
- Impact of CII on professional development of people
- Implementation experience
- Liaison and alliances
- Product distribution
- Impact on college and university curricula
- Relationships to other programs
- Global impact

A summary assessment of the combined effect of these several impacts will be presented in the conclusion of this report.

2

Quantitative Impact on Project Performance

The most direct approach to an assessment of the impact of CII is an analysis of the impact that the implementation of CII research has had on project performance. For several years, the CII membership has been concerned with the question of whether the investment in CII was paying off. It was this question that motivated the Board of Advisors to initiate the Benchmarking and Metrics program. This program has identified the following performance metrics:

Cost

- Cost Growth
- Budget Factor
- Others

Schedule

- Schedule Growth
- Schedule Factor
- Others

Safety

- Recordable Incident Rate
- Lost Workday Case Incident Rate

Other Outcomes

- Rework
- Change Orders

Implicit in the selection of these performance metrics was the assumption that all projects ultimately meet the owner's expectations, that is, at some cost and in some time frame an acceptable level of project quality is achieved.

For both the cost and schedule performance metrics, change from the planned performance would be measured, as well as a "factor" that would indicate how a project performed compared to the original budget or schedule. The results of the CII benchmarking studies are published annually.

For this assessment, the analysis of the value of the implementation of selected best practices from the 1997 Benchmarking and Metrics Report has been utilized as a measure of the impact of CII on project performance. This is considered a valid measure since there is no baseline definition of project performance prior to the creation of CII.

The best practices evaluated to date include the following:

- Pre-Project Planning (including Project Definition Rating Index)
- Team Building
- Constructability
- Zero Accidents
- Project Change Management
- Strategic Alliances
- Design/Information Technology

The 1996 and 1997 surveys established a database of 443 projects (see Figure 1), with 36 owners and 35 contractors providing project data. The total value of the projects in the database is $25.1 billion.

The analysis of the value of implementation of selected CII best practices included in the *Benchmarking and Metrics Report for 1997* is summarized in the series of graphics presented below. These portray the percent cost growth for the practice with the different levels of best practice implementation.

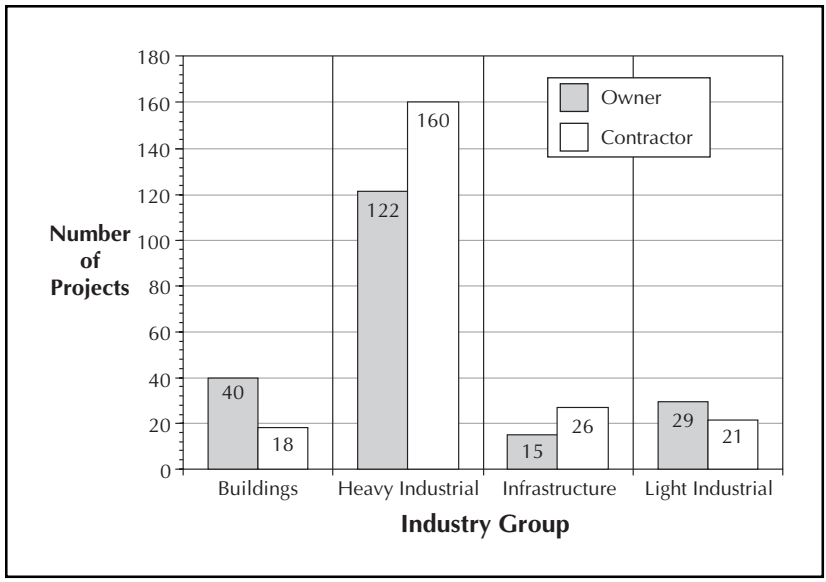

Figure 1. Database by Industry Group

Cost growth is utilized as the most direct indicator of performance. It was found most effective to demonstrate the value of implementing the best practices by aggregating the data into quartiles of the level of effort in the use of a practice. The range of values is presented in the series of box charts, which show the upper and lower levels of performance for a metric (between the 10th and 90th percentile) and the average in each quartile. The middle 50 percent of the projects in the quartile is represented by the large box in each quartile. The median is the horizontal line in the box and the average or mean is the small square.

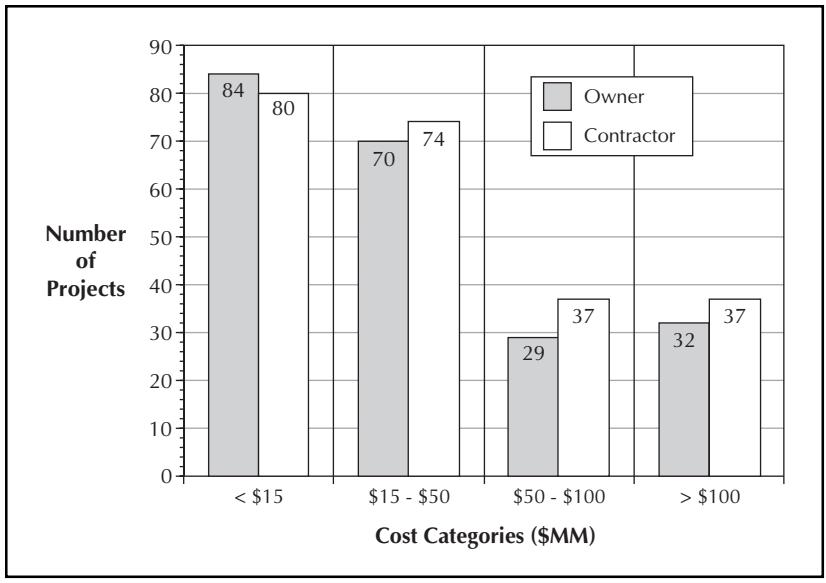

Figure 2. Database by Cost of Project

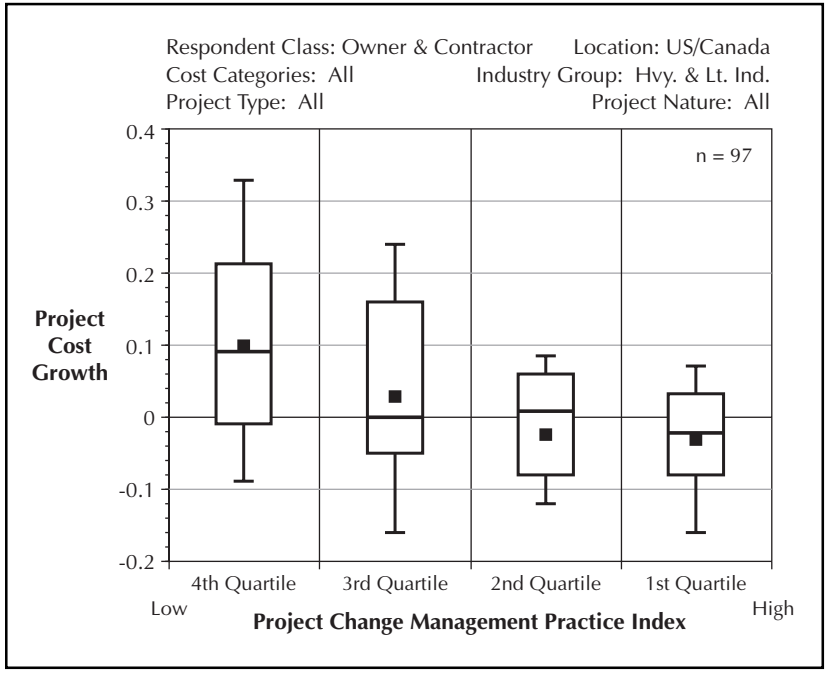

Figure 3. Project Cost Management vs. Project Cost Growth

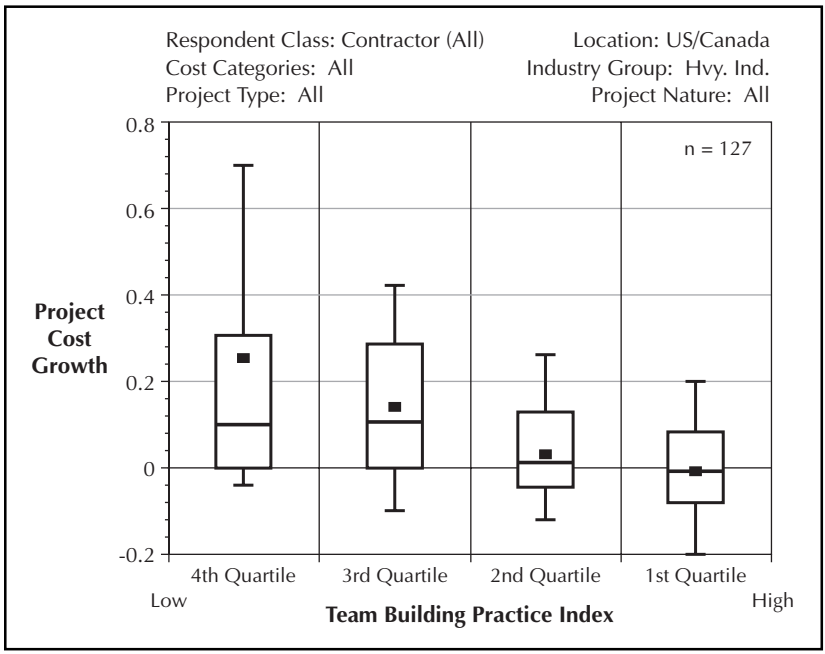

Figure 4. Team Building vs. Project Cost Growth

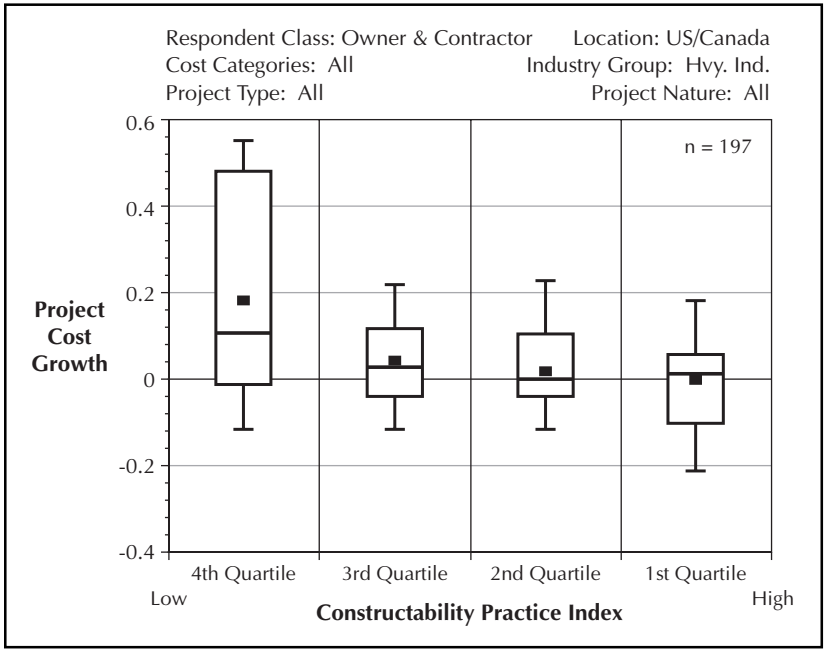

Figure 5. Constructability vs. Project Cost Growth

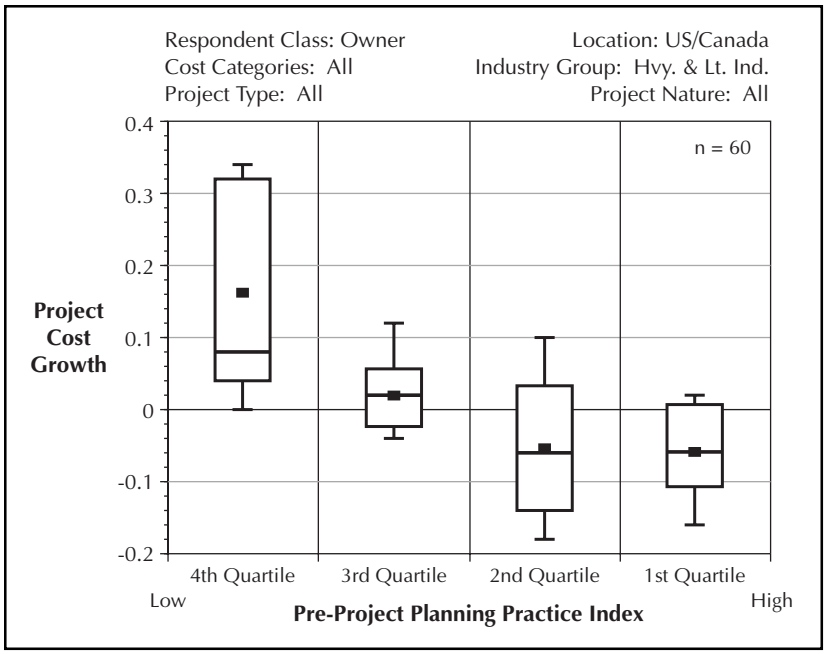

Figure 6. Pre-Project Planning vs. Project Cost Growth

It can be seen that, in most cases, not only do the average performance values improve as best practice usage increases, but the spread of performance values narrows, indicating better predictability as best practice use increases. Charts on safety practice are displayed next.

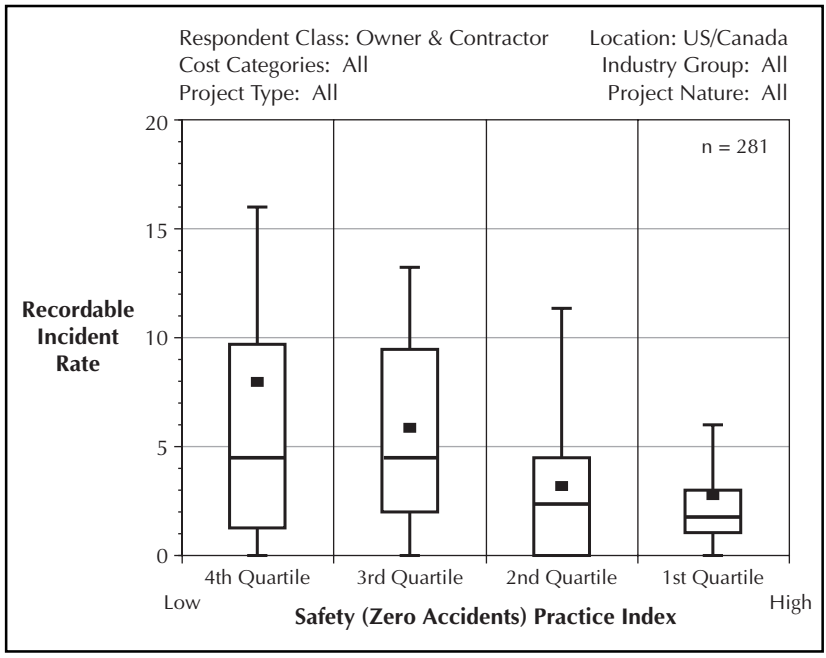

Figure 7. Safety Practice Use vs. Recordable Incident Rate

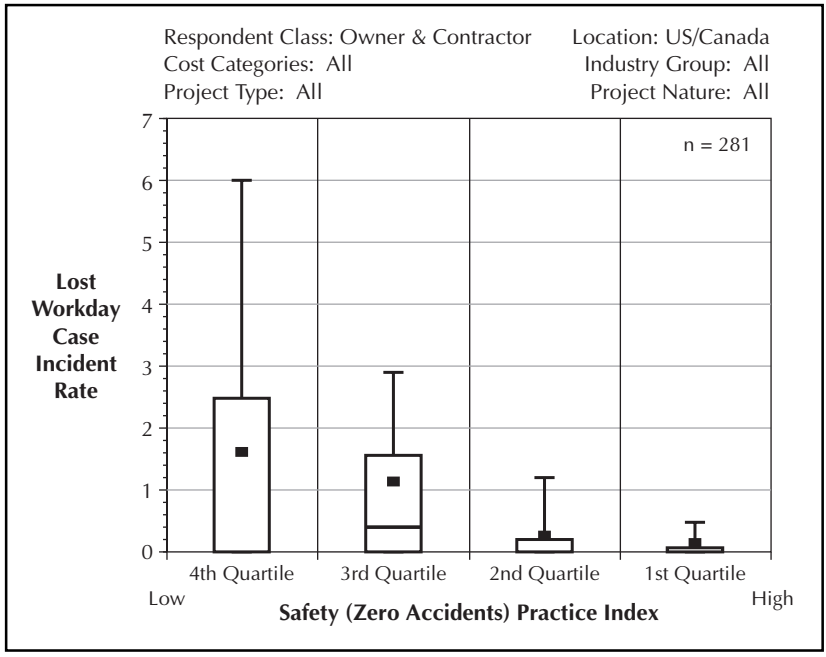

Figure 8. Safety Practice Use vs. Lost Workday Incident Rate

Figure 9 shows the impact on cost growth of the extensiver use of multiple practices. The following six best practices were included in the analysis:

* Pre-Project Planning

* Team Building

* Constructability

* Safety (Zero Accidents)

* Design/Information Technology

* Project Change Management

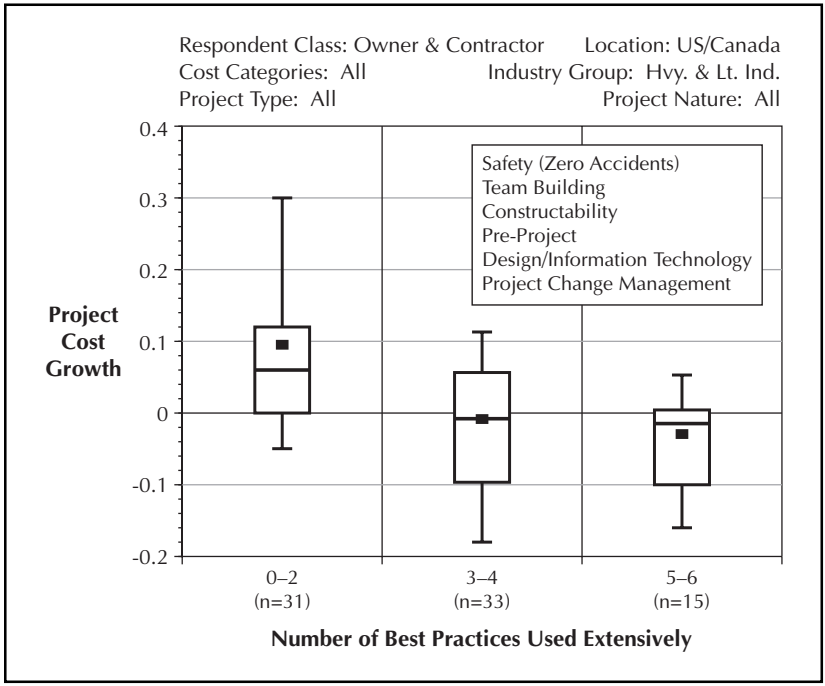

Figure 9. Project Cost Growth vs. Number of Practices Used Extensively

A similar impact occurred on project schedule growth. Figure 10 shows this impact.

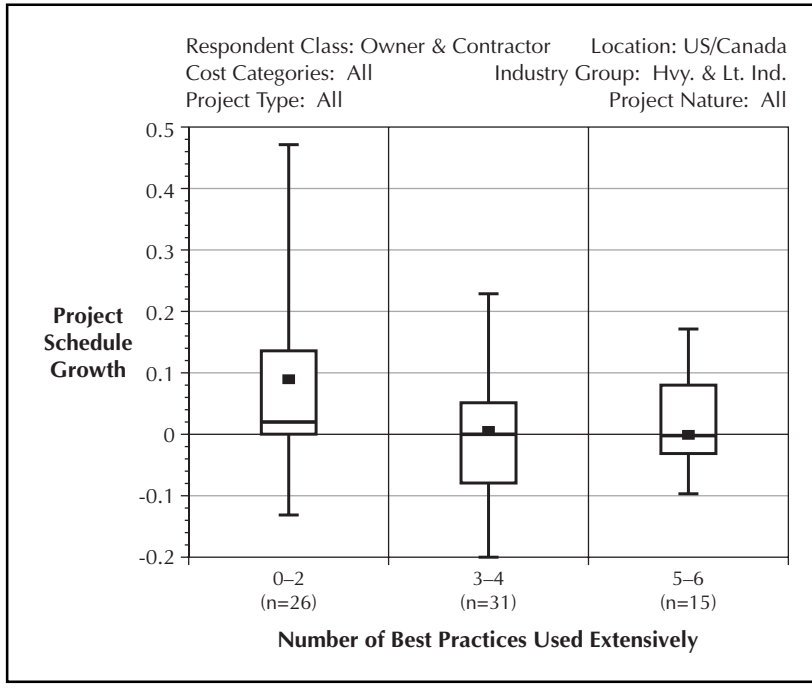

Figure 10. Project Schedule Growth vs. Number of Practices Used Extensively

While the metrics displayed above address the project performance experience relevant to the use of CII best practices, the benchmarking data have also permitted an analysis of the difference made to contractors if they worked for a CII owner and the difference made to owners if they utilized a CII contractor. The results of these analyses are presented below.

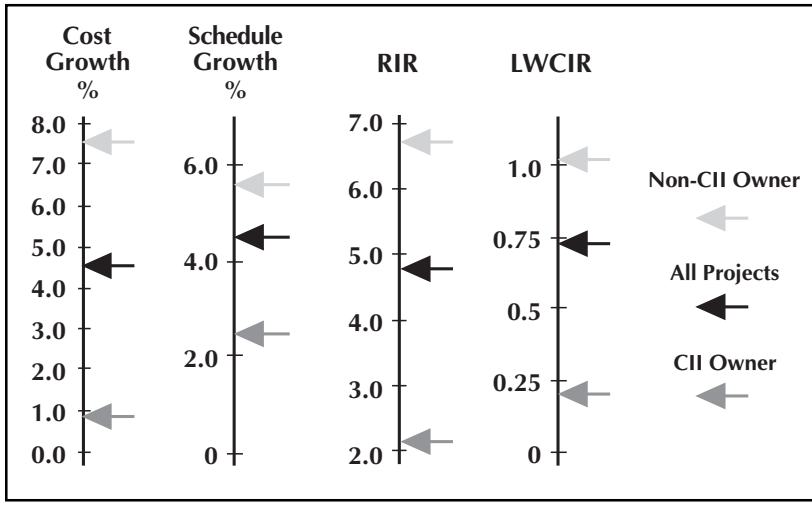

Figure 11. Owner Impact on Contractor Performance

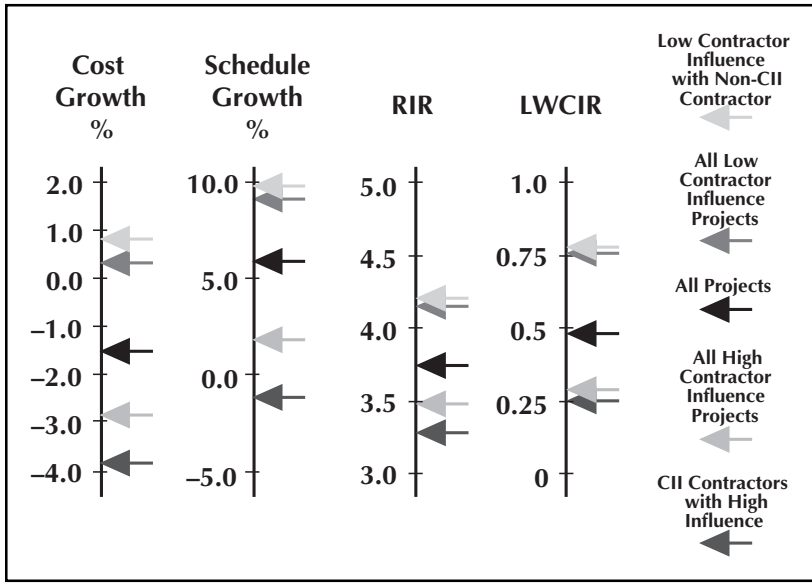

Figure 12. Contractor Impact on Owner Performance

The determination of high and low "influence" was somewhat subjective. An example of low contractor influence on project performance is a lump-sum, turnkey, construction-only contract. In contrast, a contractor working on a reimbursable basis is involved in pre-project planning, design, and construction, with team building classified as a high "influence."

Implementation Feedback Reports

Since 1994, several teams have provided information to the membership on implementation of selected CII best practices. Presentations, which reported this information, have been made at CII Annual Conferences since that time. The purpose of this implementation feedback effort has been to obtain real world information on benefit experiences of CII members in putting the results of research into practice and to provide results-based information. A total of 15 feedback reports have been prepared.

A summary of four of the more compelling feedback reports is presented below. These are illustrative of the potential for significant benefits from a comprehensive implementation effort.

Partnering/Strategic Alliances

A total of 26 owners and 20 contractors responded to a survey by this feedback team with the following results:

- Sixty-nine percent of the owners and 95 percent of the contractors were then partnering on more than $4 billion of project value, with an average project value of $150 million.
- Sixty-seven percent have increased the use of partnering.

Partnering and strategic alliances contributed directly to the success of projects 80 percent of the time. On average, schedules were reduced by 15 percent; costs by 12 percent; and change control, safety, and quality were enhanced.

Project Change Management

Of 36 responses to this feedback team's survey, representing 235 projects, 25 of the companies had an extensive project change management program, with 56 percent implementing change management practices to some extent and an additional 19 percent indicating their intent to implement these practices. Cost savings in the range of zero to 15 percent, with an average total installed cost (TIC) savings of four percent, were reported as resulting from the implementation of the best practice of change management. Strong correlation was reported between the increasing levels of change and both engineering and construction degradation of productivity. This team also concluded that significant improvement in change management is still required industry-wide.

Pre-Project Planning

Of 41 responses to a survey conducted by this feedback team, representing 598 projects, 37 percent of the companies had extensive pre-project planning implementation, with 51 percent implementing these practices to some extent and 12 indicating their intent to implement. Savings associated with the implementation of pre-project planning best practices ranged from zero to 15 percent of TIC, with an average savings of seven percent.

Schedule Reduction Techniques

Of 22 responses to a survey by this feedback team, 32 percent reported that schedule reduction techniques identified by CII were highly effective, 42 percent responded that they were moderately effective, nine percent stated that they were not effective, and 17 percent stated that they had not been used. When utilized, these techniques resulted in TIC reductions in the range of zero to 20 percent, with an average of seven percent TIC savings and schedule reductions in the range of one to 30 percent, with an average of 12 percent.

Strategic Implications

The dramatic improvement in project performance that results from aggressive implementation of best practices can have strategic implications. Consider, for example, a hypothetical company with an average capital project budget of $400 million per year with a hurdle rate of 15 percent. This company expects to generate an annual return from its projects of $60 million. Assume a modest potential total economic benefit to this owner (the value of cost, schedule, and safety improvement) of 10 percent per year—a savings of $40 million per year. This is two-thirds of the return the company expects to realize through the investment. These savings can either reduce the size of the investment program or bring new projects to the program. In considering this opportunity, it is critical to recognize that this $40 million of annual savings can be realized at a very modest incremental cost to the owner—the cost to integrate these concepts, tools, and best practices into the company's work execution plans.

3

What Has Caused This Improvement?

The underlying causes of change in any organization are always difficult to determine. Many times, change is the result of leadership direction without any outside influences. Change can sometimes be driven by an internal champion for a new idea at any level of the organization. Change often results from new technology and new competitive forces. It may also be argued that improvements in the project performance of members of CII are the result of the same internal forces that motivated those members to join CII in the first place.

While improvements in the CII membership have varied significantly, it is reasonable to judge that the implementation of the best practices analyzed in this study has been a dominant factor in this improvement.

The approach to the implementation of the CII best practices has varied among its membership. There are several "implementation models." These will be discussed in some detail later in this report. What is worth considering, however, is that several conditions are present in virtually all of the companies that have had notable success in their project performance improvement. These conditions are summarized below:

Commitment. Senior management recognizes that improvement will be economically advantageous to the company by generating enhanced return on capital, by significantly improving schedule performance, and by improving competitive position. This awareness has been translated into a commitment to drive change in the work processes.

Leadership. The leadership in the most successful companies is involved in efforts to improve. In these companies, the leadership has not simply expressed policies and established goals—it has been involved and has energized the entire improvement effort.

Culture. The culture of the most successful companies has encouraged innovation. Most importantly, the employees of these companies do not view the company culture as punitive in nature. They feel that they can implement new concepts or practices without fear that an apparent failure will adversely affect their future in the company.

Work Processes. The leading companies have realized that improvement will occur and be sustained by integrating new practices. It is not sufficient to have a few good people do something new. Real improvement comes when the new methods are institutionalized.

Core Competencies. The most successful companies have core competencies that are essential to the company's strategy. Conscious decisions are made on how to utilize the resources available in the most effective way. Inherently, this involves recognition that project management is a critical professional discipline in the capital project processes of both owners and contractors.

Integrated Project Teams. Successful owners and contractors utilize integrated project teams and aggressively pursue team building. The integrated team for an owner will typically involve the business leaders responsible for a project, as well as the project management and engineering staff and the major contractors and suppliers. The contractor integrated teams include the major subcontractors and suppliers. The contractors also recognize that they are part of the owner's integrated team.

Individual Professional Development. All successful companies recognize that people are their most critical resource. These companies also recognize that capital projects are changing with new technologies, markets, and competitive pressures. These companies actively support professional development.

Commitment of Resources. The leaders in the industry put resources to work in support of all of the factors described above. They recognize that setting policies and exhorting their people to be better is hollow leadership without the commitment of resources to permit people to address the work necessary to improve their work processes and to put new ideas into practice.

Improvement in project performance is not an accident or a result of senior management simply wanting it to happen. It results from organizational and cultural change. CII has been a catalyst for this change and has helped companies to meet challenges, to eliminate complacency, and to find better ways to perform projects.

4

The CII Impact on Professional Development

The primary ingredient of success in the capital project process is the effectiveness of the people in the process. This effectiveness is a function of many factors, with professional competence being the most significant. While effective work processes are undoubtedly necessary, it is the people who design and refine the work processes, and implement them on a continuing basis. Judgment is often required in the application of the work processes to assure that the specific constraints of a project are accommodated and that the project objectives are realized. It is clear then that one of the most significant contributions of CII is the opportunity that it has created for supporting the professional development of the people employed by its members.

Participation in CII activities has been considered vital to the success of CII since its inception. This participation includes representation on the Board of Advisors, the data liaison and benchmarking associate representatives in each member company, participation on the several committees and councils of CII, the alliance steering committees and, most importantly, the research, education, and implementation teams.

Active CII Participation

A total of 2,573 volunteers have participated in CII activities, with an additional 501 participating in the Process Industry Practices program. While volunteers have participated in many activities, the largest effort has been in work of the 1,349 individuals involved in the research teams. Volunteers also have contributed to the following activities in the approximate numbers shown:

Board of Advisors	596
Executive Committee	45

Strategic Planning Committee	30
Implementation Strategy Committee	34
Finance Committee	12
Education Committee	30
Research Committee	27
Membership Committee	61
Globalization Committee	10
Benchmarking and Metrics Committee	16
Liaison Councils	58
Alliance Steering Committees	13
Implementation Teams	115
Education Teams	162
Ad Hoc Committees	15

Annual Conference Participation

In addition to this participation in the ongoing work of CII, others have benefited from their participation in the CII Annual Conference, both by being program participants and by attendance at the conference and its workshops. In the 13 conferences which have been conducted, a total of 6,026 registrants have participated. Many of these, of course, have been participants in other CII activities.

CPI Conference Participation

Another significant annual event, the Construction Project Improvement (CPI) Conference, has involved 3,240 CII people. Since 1995, this conference has essentially been a repeat of the content of the Annual Conference. The majority of the participants in the CPI Conference are not active in other CII work.

Continuing Education Participation

The CII Construction Education Short Course (CESC) program was conceived as a vehicle for communicating the results of CII research in a formal classroom setting using educational modules prepared by CII to enhance the value of the research reports. A total of 80 courses have been presented at The University of Texas at Austin, Clemson University, and Arizona State University, with a total of 1,844 class participants.

The education modules were developed so that they could be used as part of in-house programs by the CII members and by any company in the industry. A total of 2,031 modules have been sold. The modules also were prepared for use as a resource for CII speakers in support of other organizations such as the Local User Councils of The Business Roundtable. A total of 354 presentations have been made to such groups, with an average attendance of 40 people.

University Participation

A major element of professional development has been the impact of CII on university faculty and graduate students who have been involved in CII research. At 34 universities throughout the U.S., 71 faculty members and 130 graduate students have participated in CII. The benefit for these individuals is the opportunity to interact with industry representatives and to receive exposure to real world problems in the projects involved in their studies. Through this interaction and industry exposure, the graduate students are upgraded before they enter the industry as professional participants. There is a reasonable assumption that these individuals are more readily employable than they otherwise would have been.

This academic involvement also has had an impact on the curricula of undergraduate engineering courses related to construction engineering and project management. This involvement will be considered in a later section of this report.

Early in its operations, CII contributed $50,000 to the development of an executive education program addressing the construction industry. First presented at Stanford University, it is now presented each year at Texas A&M University. This program, which has utilized CII material as a significant resource, has made a major contribution to the effectiveness of the capital project industry.

Networking

A major benefit of CII is the networking among the people who are involved. Networking provides the participants in CII a broad industry perspective and an opportunity to hear experiences others have had and solutions others have utilized in addressing problems. Owners and contractors have developed better understandings of the issues facing each other and have formed the basis for mutual respect and trust.

Has CII contributed to professional development? Over 11,000 people have been involved in CII. Each has had an opportunity to work with others in addressing industry problems. These volunteers have brought their experience to bear on these problems and have contributed to CII research and CII products. Without question, CII has created the opportunity for professional development. It is difficult to believe that the improvement in project performance described earlier could have taken place without significant growth in the professional capabilities of the people involved.

5

Implementation Experience

CII members have pursued implementation in different ways. Several features, however, are common to most of the companies that have had significant success in this effort. All have made a corporate commitment to use CII best practices, and have policy statements that communicate throughout the company the commitment of the leadership to improving their capital project processes through membership in CII. Many members have created steering committees to provide direction and leadership to the implementation efforts. In most cases, members appoint a corporate champion for implementation of CII best practices. Most of the successful members have established some formal structure to focus their implementation efforts.

One significant difference among the members is in the approach to implementation. Some drive the implementation effort from the senior leadership into the operating levels of the company. Others have encouraged the operating levels to take initiatives to integrate the CII best practices into their work processes, an approach that is highly dependent on the emergence of champions in the organization.

The successful members have been sensitive to the impediments to implementation:

- Complacency
- No Resources
- No Time
- Champions of the Status Quo
- Project Managers Who Resist Change

Implementation Model

The Implementation Strategy Committee, after studying all aspects of the implementation challenge and after considering the experience of the most successful companies, has defined an Implementation Model that is described in Figure 13 below.

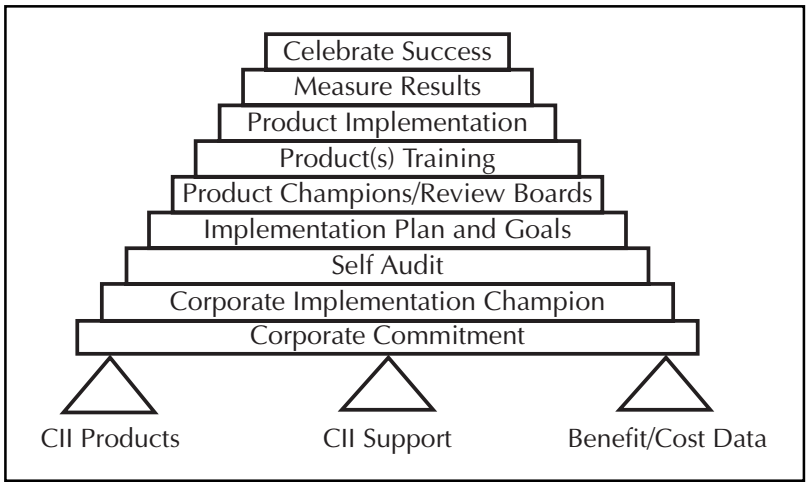

Figure 13. The Implementation Model

This model rests upon three supports as the foundation—CII products, CII Support, and Benefit/Cost Data. The underlying assumption is that a company with a commitment to improvement of its project processes will be aware of the results of the benchmarking program and will utilize the CII products as a primary resource.

Samples of Implementation Efforts by Members

Some members have been notably aggressive and successful in their implementation efforts. For example:

An oil company initiated a tailored education program focused on CII products utilizing outside facilitators. A three-and-a-half day program was developed and has been presented 20 times with the content varying over time.

Another oil company has utilized the results of CII benchmarking to convince its senior management that a formal effort is justified to upgrade the company's project processes utilizing CII best practices.

A government agency initiated a formal training program covering selected CII best practices using both CII staff and outside instructors who were also involved in the short course program.

A joint venture between a CII owner and a contractor member has created an academy to teach project management skills. This program uses CII products as one of the primary resources.

Implementation of Selected CII Products

Several CII products have been widely implemented with highly effective results. For example:

When the original CII constructability concepts were published, the idea of integrating construction knowledge and experience into all phases of a project was new to most in the industry. Now this approach is generally accepted.

Materials management has always been recognized in principle as an important aspect of project execution. Prior to the publication of the CII Publication SP4, *Project Materials Management Handbook*, this particular function had been performed with a low level of effectiveness. The CII products led the way to a major upgrading of this important function throughout the industry. This original product has been updated and redistributed.

CII products addressing zero accidents and workers' compensation have heightened the awareness that exceptional safety performance is possible. CII's benchmarking studies have demonstrated that it is good business to apply the CII safety concepts and best practices.

Partnering and team building have brought about significant results. These cooperative relationships are built to a great degree on the concept of the CII cost/trust research, which demonstrates that a

relationship based on rational trust is beneficial to both an owner and a contractor. Other research efforts also have produced material relating to these best practices.

Pre-project planning has been used to improve project definition. The concepts assist the owner in evaluating readiness to fund a new project. Several contractors have used the principles expressed in these products to improve their efforts in planning new projects and to enhance their project-based communications with owners.

Summary

This discussion of the implementation experience of CII members provides evidence of the impact that CII has had on the way its members plan and execute projects. A company that commits itself to improvement and utilizes the results of CII research as a resource can improve its work processes while enhancing professional development. Companies implementing the CII best practices will improve their project performance in all areas—cost, schedule, safety, and quality. These companies will realize the benefits of excellence in their capital project processes, will gain improved returns on their investments, and will substantially improve their competitive position.

6

Liaison and Alliances

CII recognizes the value of maintaining mutually beneficial relationships with other organizations that have an interest in improving the effectiveness of the construction industry. The initial CII approach to establishing and maintaining liaison was the establishment of several liaison councils as described below.

Contractor Association Council. This council was created to maintain a linkage between CII and six major contractor associations:

- Associated General Contractors of America
- Associated Builders and Contractors
- National Constructors Association
- Sheet Metal and Air Conditioning Contractors National Association
- National Electrical Contractors Association
- Mechanical Contractors Association of America

Professional Societies Council. This council was created to maintain a linkage between CII and several professional societies such as:

- American Institute of Architects
- American Society of Civil Engineers
- American Welding Society
- American Concrete Institute
- American Association of Cost Engineers
- American Institute of Chemical Engineers

- American Society of Mechanical Engineers
- Industry Applications Society
- Institute of Electrical and Electronic Engineers
- Instrument Society of America
- National Society of Professional Engineers
- Project Management Institute
- Society of American Military Engineers

Research Centers Council. This council was established to assure a high degree of coordination among the several research organizations that address construction industry issues. This council makes significant input to the CII Research Committee as it formulates its proposed annual research program to the Board of Advisors. The council includes the following:

- Federal Facilities Council (observer)
- Lehigh University Center for Advanced Technology for Large Structural Systems
- MIT Center for Construction Education and Research
- NIST Building and Fire Research Laboratory (observer)
- U.S. Air Force Civil Engineering Laboratory
- U.S. Army Corps of Engineers Construction Engineering Research Laboratory
- U.S. Naval Civil Engineering Laboratory

Construction Suppliers Council. This council addresses the role that suppliers play in the capital project process. One workshop sponsored by the council brought together representatives of several

pipe fabricators to explore the impact of the use of 3D/CAD systems by contractors on the fabricators. The workshop developed insights and provided specific input to the Piping Process Research Team.

Academic Council. This council was established to maintain a continuing dialogue with those in the academic community involved in teaching construction industry related material.

The Business Roundtable Council. This council was created to sustain the close working relationship between the Construction Committee of The Business Roundtable and CII.

International Council. This council was established to address the question of the proper role of CII in support of its members who operate internationally. This council ultimately was replaced by the Globalization Committee.

The concept of liaison councils has not been uniformly successful. In both the Contractor Associations Council and the Professional Societies Council, there has been such a diversity of interests among the several participants that only general awareness of CII and its program was developed.

Through experience, it became apparent to CII that some form of one-on-one relationships with selected organizations would be more effective than the councils. From this, the concept of alliances evolved. CII has entered into two alliances with contractor associations—the Mechanical Contractors Association of America (MCAA) and the Associated Builders and Contractors (ABC). Both of these alliances have been successful. The ABC alliance has resulted in the joint funding of a multiskilling research project. The MCAA alliance resulted in a project management training program taught at The University of Texas at Austin.

One of CII's original councils, The Business Roundtable Council, recently evolved into a three-party alliance between CII, The Business Roundtable, and the Engineering and Construction Conference (ECC) of the American Institute of Chemical Engineers (AIChE). The Project

Management Institute (PMI) recently formalized an alliance with CII. In addition, the Construction Industry Forum of the American Bar Association became part of an alliance with CII. The ABA and CII anticipate that joint efforts will improve the way in which the industry deals with adversarial relationships and disputes.

As CII explored the direction it would take in the globalization area, the European Construction Institute, which is based on the CII model, suggested a formal alliance. This alliance is in its early stages of operation.

CII now considers that the alliance concept is an effective way of maintaining linkages with other organizations.

The Academic Council, the Research Centers Council, and the Construction Suppliers Council continue to function as originally conceived and continue to add value to CII and to the industry.

CII also maintains liaison relationships with several other organizations. A CII Associate Director serves on the Steering Committee of the Dispute Avoidance and Resolution Task Force (DART), which is sponsored by the American Arbitration Association. CII Associate Directors also serve as liaison representatives to the Federal Facilities Council of the National Research Council and participate in the National Council for Civil Engineering Research, which is sponsored by the Civil Engineering Research Foundation.

7

Product Distribution

The distribution of CII products is indicative of the impact of CII since its creation in 1983, particularly its impact on organizations that have not been members of CII. A total of 80,000 copies of publications have been distributed to the CII membership. Members utilize these in different ways, but the greatest impact of the publications has been on project performance and professional development.

Distribution Beyond CII Membership

Routinely, five copies of each research summary and one copy of each research report are distributed to each member organization. At best, there is limited information available about the full extent of the distribution of CII products beyond the membership, primarily because CII does not copyright its publications, with the exception of its education modules. It has been the intent of CII to support improvements in the industry at large, not just the performance of its members. To this end, CII has underwritten the sales of its publications in the amount of over $100,000 per year and has encouraged copying and distribution of the publications within other organizations. A total of 220,054 publications have been sold, the majority of which have been purchased by organizations which are not CII members. In addition, 2,031 education modules have been sold.

In 1994, CII established its Product Subscriber Program (PSP). The PSP is not a class of membership, but does assure the participants that they will receive copies of publications as they are first released. This program also provides the subscribers admission to the Construction Project Improvement Conference. A total of 2,580 publications have been distributed through this program. This is included in the sales numbers noted above.

CII also provides copies of its publications to its alliance partners. This has generated sales of these publications to the members of the alliance partner organizations with some unknown level of copies within these organizations.

Some indication of the impact of this product distribution can be seen in an analysis of the most popular publications. The following is a listing of the sales volume of the top 10 research summaries:

Management of Project Risks and Uncertainties	*8,564*
Work Packaging for Project Control	*7,623*
Managing Subcontractor Safety	*7,136*
Scope Definition and Control	*5,907*
Contract Risk Allocation	*5,816*
Impact of Various Construction Contract Types and Clauses on Project Performance	*5,699*
Constructability: A Primer	*5,634*
Project Control for Engineering	*5,429*
The Quality Performance Management System: A Blueprint for Implementation	*5,041*
TOTAL	66,367

The total distribution of CII products has been approximately 303,000. Assuming that each publication has been copied once, then it is probable that approximately 600,000 CII publications of some form have been in circulation in the industry at large.

8

Impact on College and University Curricula

It was originally intended that CII be a three-way partnership among owners, contractors, and academia. It also was intended to utilize the capacity of the colleges and universities with construction-related programs to perform much of the research. The faculty at these institutions had the potential for addressing industry issues without bias and in a way that the industry would accept the credibility of the results. CII members believed that the effectiveness of the academic research effort would be enhanced through a close and continuing relationship between the researchers and industry. This has been accomplished through the creation of research teams with representation from both owners and contractors. Each research team has had one or more academics assigned. In most cases, these academics also performed the research. The universities and faculty members were selected to perform CII research on the basis of their competence in the subject area. Faculty members serve as principal investigators, assisted by one or more graduate students. The researchers are directed by the research team.

There was a clear intention from the beginning that this exposure of faculty and graduate students to current industry issues as identified by the Board of Advisors would contribute to the effectiveness of university-level construction education programs.

During the early part of 1998, 26 of the 71 faculty members involved in CII research were contacted to determine the extent to which CII has impacted the college and university curricula. It is believed that this sample is representative of how CII has had an influence on higher education. The responses can be summarized as follows.

CII has had both a direct and indirect impact on construction education. The direct impact has involved the incorporation of the content of CII products directly into many different courses as text material, references, and research resources. This impact has been primarily in graduate courses. The following CII publications were identified as being frequently utilized:

- Materials Management
- Bar Coding
- Total Quality Management
- Constructability
- Pre-Project Planning
- Safety
- Schedule Compression
- Continuous Assessment of Project Performance
- Cost and Schedule Control
- Project Controls
- Partnering
- Team Building
- Project Organization
- Productivity Measurement
- Risk Management
- Project Objectives Setting
- Change Management
- Owner/Contractor Work Structure

- Alternate Disputes Resolution
- International Alliances
- Use of Incentives
- Contractor Planning for Fixed-Price Construction
- Design/Build

At one university, 40 percent of the content of the graduate level Construction Engineering and Project Management Program is now based on CII publications. Another university's program has been totally revised using CII materials.

The indirect impact has primarily influenced the faculty members and has resulted from their association with industry practitioners on their research teams. One professor wrote, "My professional growth as a professor of construction has been significantly influenced by my service on CII teams and committees."

It appears that a large percentage of the graduate students in construction programs have been exposed to CII material, either through their participation on CII teams or through their course work. The judgment is that this impact is positive and significant. It is also clear that there is an opportunity for CII to do more in producing materials that are user friendly for the academic community.

9

Relationships to Other Programs

Process Industry Practices (PIP) Program

As several of its members began to realize the benefits from the implementation of research, CII started looking for other ways to improve capital projects. Several members recognized that in the process industry a proliferation of practices and non-society standards were being utilized by owners and contractors. The view of these members was that significant costs were being incurred for little, if any, value.

From this, a small number of CII members joined with several nonmembers to seek a way to minimize this proliferation. This initiative was named Process Industry Practices (PIP) and was formally established in 1993 with 14 founding members. The members of this initiative requested that it function under the umbrella of CII. PIP is a separately funded element of CII, with each member contributing $25,000 per year. Its mission is to harmonize the non-society standards and practices used by owners and contractors in the process industry. The membership of PIP is now 30. The participants in the program are convinced that the use of the new standards will reduce total installed costs of process plants by at least five percent.

Volunteers working in function teams perform the work of PIP. Through 1998, a total of 510 volunteers have participated in teams addressing the following areas:

- Civil/Structural/Architectural
- Electrical
- Environmental
- Insulation
- Machinery

- P&ID
- Piping
- Process Control
- Vessels

To date, 258 practices have been published, with 19 ready for distribution. Fifty-four are under review, with 94 more in the development process. Two hundred sixty-seven additional practices have been identified for future work. In addition, PIP will increase its contacts with suppliers to obtain their input and will focus on the implementation of the practices.

The PIP initiative is fully consistent with the concept of CII. PIP is not a research function, but rather utilizes the experience of its participants to develop practices which are of great value to the process industry.

Sloan Program

In 1996, the Alfred P. Sloan Foundation provided a grant to The University of Texas at Austin in the amount of $2 million for construction industry studies. The grant was made to fund studies for a three-year period with a potential for additional funding beyond this initial period. In conjunction with this grant, CII made a commitment to contribute $225,000 over a three-year period to the Sloan Program.

The Sloan Foundation provides funding to a total of 12 centers of study, including the program at UT Austin. The focus is to broaden the understanding of the construction industry and to contribute to industry improvement through a series of multi-disciplinary studies of key industry issues. At UT Austin, the Sloan Program is strongly linked to CII. Dr. Richard L. Tucker, Director of CII, is also Director of the Sloan Program.

The first Sloan construction studies address the following areas:

- Fully Integrated Project Processes
- Owner Organization Changes

A study to address Construction Work Force Issues was initiated in the fall of 1997, with a fourth topic to be added in the early part of 1998 to address technology trends.

It is the intention of the leadership of both CII and the Sloan Program that their research efforts be fully coordinated to the long-term benefit of the industry.

10

Global Impact

Many countries have taken considerable interest in the establishment of CII. Many professionals and academics recognize that the construction industries in their countries have many of the problems identified by The Business Roundtable CICE Project, and that there is the same need for improvement.

As CII grew and completed its first research, representatives from Australia, Canada, Israel, Korea, Japan, and the United Kingdom visited its headquarters in Austin. Several countries requested Dr. Tucker and others of the CII staff to visit to explain CII and how it operates. A counterpart organization has been created in Australia. In the United Kingdom, an initiative was undertaken to establish a European Construction Institute. CII has freely offered advice and assistance in the creation of these counterparts. In 1995, CII and the European Construction Institute conducted a joint seminar in Amsterdam. In 1997, CII and ECI established a formal alliance. Several members of ECI are now participants in the CII Benchmarking and Metrics Program.

CII recognizes both a need and an opportunity to provide support to its members in the area of the globalization of the construction industry. In 1990, a CII International Council was established to address this need and opportunity. This council ultimately was replaced by the Globalization Committee. This committee has conducted forums to assist CII members who are interested in the specific conditions concerning planning and executing projects in China and Brazil. Additional forums are planned for other geographic areas.

As globalization expands, CII will continue to support the development of counterpart organizations and to provide support to its members.

The impact of CII in globalization, although not measurable, has been significant.

11

Summary

Has CII taken a leadership role in research into ways to improve the capital projects industry? Has it met the need set forth in the CICE Project for some organization to address the opportunity to improve the cost effectiveness, schedule performance, safety, and quality of capital projects?

Consistent with its original objective, CII continues to be primarily a research organization. Over the past 15 years, the Institute has developed effective approaches to the identification of research topics and for the accomplishment of its research involving both representatives of its members and academia. All research has inherent risks and not all is successful. CII has found that a limited number of its research studies have failed to meet its standards for publication and has not distributed these reports. In one case, a research team on one subject dissolved itself when it became convinced that its work was not going to add value to the industry. Given the nature of the industry, however, this assessment concludes that the CII research effort has been highly successful and has provided the foundation for effective CII implementation support and education programs.

Although its focus is not on research, the Process Industry Practices program has also contributed substantially to industry improvement with a potential for an even greater contribution as it completes its work in harmonizing industry practices.

The data presented in this assessment indicate that a significant amount of research has been performed under the auspices of CII. One hundred thirty-one research reports have been published addressing a wide range of subjects. The subjects have been those that the industry has identified as being important. Over 300,000 copies of CII publications have been distributed throughout the CII membership and the industry at large. More than 11,000 people have been involved in CII activities, which has contributed to their professional development.

The Continuing Education Short Course program has presented 80 one-week courses at three universities with 1,844 class participants. Seventy-one faculty members at 34 universities with graduate students have been engaged in CII research. This, with the associated interaction among academics and the industry, has contributed to an advancement in the quality of construction education. Through various liaison mechanisms, CII has interacted with others both in North America and on a global basis to share the results of its research.

The ultimate question, however, in evaluating the impact of CII is whether it has made a difference in project performance. The results of the Benchmarking and Metrics program provide the best answer to this question. The data presented in this assessment indicate that where six of the CII best practices (Pre-Project Planning, Team Building, Constructability, Safety, Design/Information Technology, and Change Management) are effectively employed (used extensively), substantial cost, schedule, and safety performance improvements have resulted. These data confirm many case studies presented at CII Annual Conferences that have described notable success in implementing the results of the research. Several feedback reports have further confirmed payoff from the use of selected best practices. The economic benefits to both owners and contractors who use the results of CII research are significant, demonstrating that the investment inherent in CII membership is returned many times over.

The cost growth difference between projects using five to six best practices and those using zero to two best practices extensively was 12 percent. The schedule growth difference between these projects was nine percent.

There also is evidence to suggest that many CII members and much of the industry at large have not been effective in integrating these best practices and the results of CII research into the way they plan and execute their projects. There remains a major untapped opportunity for project improvement among both owners and contractors. CII will not fulfill its potential until this opportunity has been grasped industry-wide, as well as by the full CII membership.

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Not printed with state funds

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