CII: THE FIRST TEN YEARS

AUGUST 1993

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by
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and
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FOREWORD

I am privileged to serve as Chairman of the Board of Advisors of the Construction Industry Institute for 1993, the tenth year of CII's operations. As a member of the Board of Advisors, as well as a former task force chairman, I am aware of how well CII has performed its mission and achieved its goals during these first ten years. As a partnership of owners, designers, builders, and academia, CII has addressed many serious problems in the construction industry. Through its research, implementation, and education programs, CII has improved our industry's quality and cost effectiveness. The primary reason for this success has been the participation of over 2,500 volunteers with the full support of their member organizations.

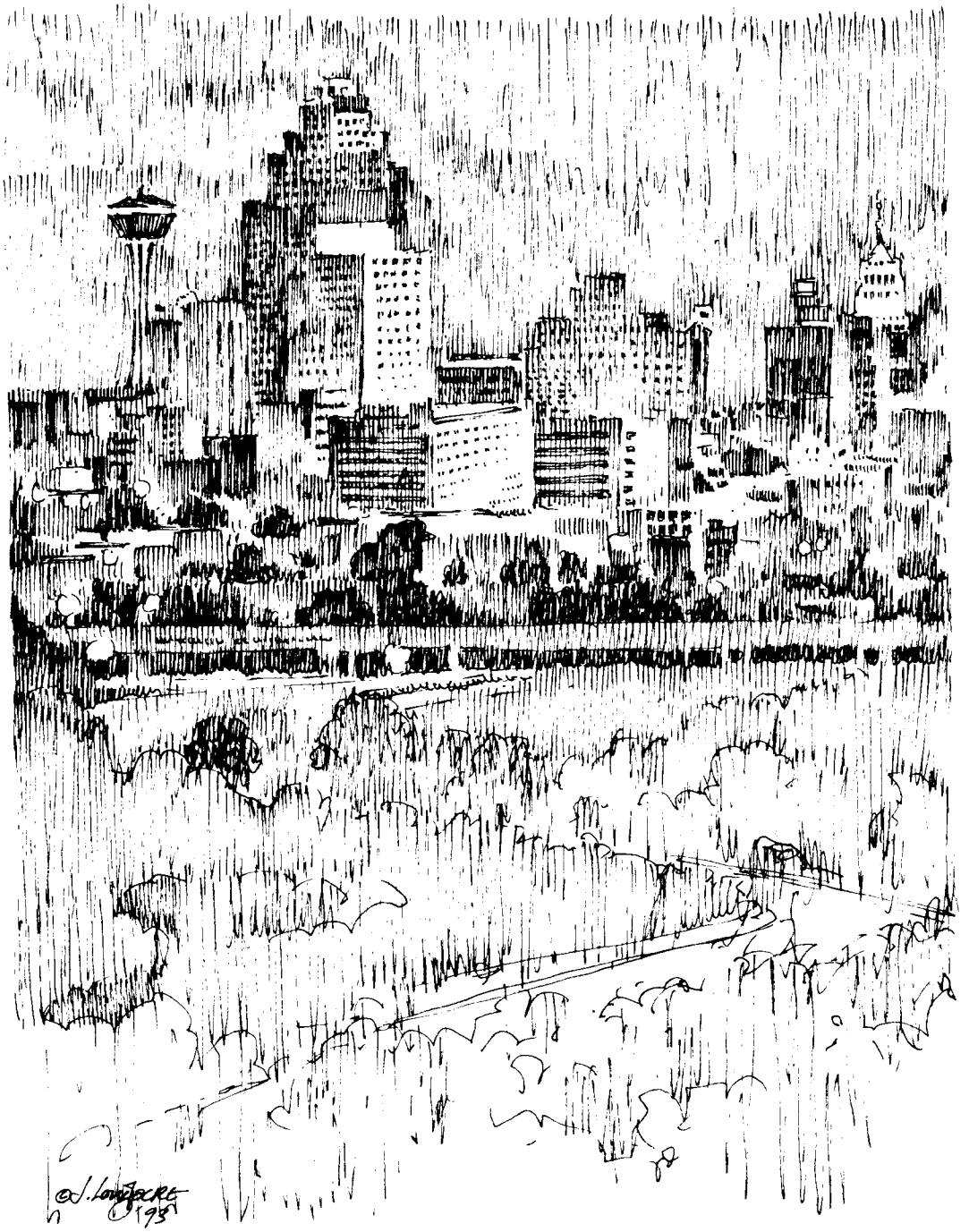
The following chapters provide a description of the conditions in the industry and in the academic community that preceded the formation of CII. Also described in some detail are the efforts of The Business Roundtable's Construction Industry Cost Effectiveness (CICE) Project, completed in 1983, which provided much of the stimulus for the creation of CII.

The story of the founding of CII, which took place in less than nine months, will be of particular interest to construction industry professionals. It demonstrates what dedicated people can do when they join together to address industry-wide problems.

Notwithstanding CII's successes in its first ten years, much remains to be done. There continues to be a need for further research. The implementation and education programs of CII are in their early stages and hold high promise as the next plateau for further improvement in our industry. Measurement will also be key to our future efforts. As the national forum for the construction industry, CII is providing meaningful leadership for managing the changing world of engineering and construction.

I congratulate and thank all who have made CII successful so far, and I look forward to working with those who will make it successful in the future.

Richard R. Bryan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Chapter 1

SAN ANTONIO: AUGUST 1993

On March 25, 1993, several members of the CII staff and 1993 CII Annual Conference Chairman Gordon R. Denker of The Procter & Gamble Company met in Atlanta, Georgia. The purpose of the meeting was to evaluate several presentations by CII task forces and CII member companies. The presentations represented candidate topics for the 1993 Annual Conference. The staff and the conference chairman heard 23 separate presentations, and the following day the group selected about one-half of those presentations to comprise the program for the Annual Conference that would be held in August in San Antonio, Texas. Each year the conference addresses a wide variety of topics concerning the mission of CII: to improve the total quality and cost effectiveness of the U.S. construction industry to enhance the competitiveness of American business in the global marketplace.

During the week of August 1, 1993, representatives from more than 90 U.S. manufacturing corporations, engineering and construction contractor firms, and leading U.S. universities were expected to gather in San Antonio to participate in CII's ninth Annual Conference. Conference attendance was expected to total over 600 persons.

Before the conference plenary sessions on August 4 and 5, some 30 CII task forces would meet earlier in the week to review the status of research underway on such diverse subjects as computer integrated design and construction, environmental remediation technology, pre-project planning, the impact of the Americans with Disabilities Act (ADA), dispute prevention and resolution, workers' compensation, and total quality management. In addition, the Executive Committee would meet as well as other CII committees, councils, and action teams.

The Annual Conference plenary program consisted of the following presentations:

- "Target: Zero Injuries" A Report from the Zero Injuries Task Force
- "The Value of Quality Reviews" A Case Study by DuPont and MK-Ferguson
- "Let Reason Prevail" A Report from the Disputes Prevention and Resolution Task Force
- "TQM at Work" A Case Study by Chevron and Bechtel
- "Americans with Disabilities Act" A Report from the ADA Impacts Task Force
- "Cost-Trust Relationship" A Report from the Contracting Phase II Task Force
- "Team Building: The Next Plateau" A

Case Study by Star Enterprise (Texaco, Saudi Refining Inc.), Bechtel, and Brown & Root Braun

- "International Standards and You" A Report from the International Standards Task Force
- "Competing in the Global Market" A Report from the International Construction Task Force
- "A Process for Measuring Project Quality" A Report from the Quality Performance Measurement Task Force
- "Schedule Compression" A Case Study by J. A. Jones Construction Company
- "It's Time to Think About Insurance Costs" A Report from the Insurance Task Force
- "Front End Planning in the Building Sector" A Case Study by CUH2A, Turner Construction, and Hubert, Hunt & Nichols

A unique feature of each Annual Conference is the CII Forum. The Forum features a panel of experts who debate a topic of timely interest to the industry. The 1993 Forum concerned the restructuring of U.S. corporate engineering organizations, and included the following presentations:

- "Capital Investments for Productivity and Profit, Not Fulfillment of Engineering Careers" by John Correnti, Nucor Corporation
- "Why Companies Like DuPont Have to Change the Way They Do Business" by Mike Emery, DuPont
- "Engineering Life Does Exist after Decentralization and Downsizing—A Survivor's View" by Tolly Pruitt, Hoechst Celanese Corporation
- "A New World for the Contractor—Opportunity and/or Threat?" by Ted C. Kennedy, BE&K, Inc.

Keith Dodson, President and CEO of John Brown E&C and a former chairman of the CII Executive Committee, would moderate the Forum. Richard Masica of Texaco would moderate the Forum breakout session.

The CII is a unique partnership of owners, contractors, and academia. It has provided a model for other similar organizations, both domestically and internationally. CII will celebrate its tenth anniversary in October 1993. Originally established with 28 founding members, CII now has 92 member companies and has sponsored research at over 30 universities throughout the United States. Implementation of the results of this research by CII members and by the industry at large has resulted in significant cost and schedule savings, improved quality and safety performance, and also has reduced the adversarial nature of owner and contractor relations.

This is the story of how concerned professionals in the industry have joined together to share their knowledge, experience, and ideas in an effort to improve the construction industry for the overall benefit of U.S. businesses worldwide.

Chapter 2

THE U.S. CONSTRUCTION INDUSTRY 1968-1982

In November 1968, Winton M. Blount, President of the United States Chamber of Commerce, chaired a National Conference on Construction Problems, which was held in Washington, D.C. Approximately 160 individuals from organizations representing contractors, contractor associations, owners, and government addressed a wide range of issues concerning major problems in the U.S. construction industry. Their discussions reflected serious concerns regarding the impact of increasing construction costs on inflation. At the conclusion of the conference, a task force was formed to prepare recommendations for improving contractor/union relations and contractor/client relations.

The task force released its report in July 1969, and recommended two fundamental steps to improve conditions in the industry. First, an organization of major purchasers of construction services should be formed to establish responsible and informed cooperation among purchasers of construction. Second, the task force proposed that contractors establish an organization that would be a counterpart to the purchasers organization. The task force suggested that these two organizations, working separately and jointly, could define their proper spheres and initiate a remedial program. The program conceived by the task force would address the following principal areas:

- Inventory the labor skills available in the various trades; project future labor requirements of the industry; develop programs to better recruit needed personnel, including minority groups; and train and provide for greater mobility of the work force.
- Strengthen collective bargaining.
- Recommend legislation tailored to the needs of the construction industry.
- Strengthen dispute settlement procedures and devise new settlement procedures.
- Eliminate restrictive work practices.
- Reduce effects of seasonality.
- Review the role of national and project agreements.
- Adopt plans for the administration and financing of activities necessary to support these programs.

At the time of the National Conference on Construction Problems, the construction industry faced serious problems. The National Association of Manufacturers had published, "Chaos in the Construction Industry," which includes this summary statement:

"Labor conditions in the $90 billion construction industry have reached dimensions that demand urgent action by top management executives. Some of the decisions required may be painful, but the problems are too crucial to be avoided." The paper concludes: "The labor problems in the construction industry have reached the stage where ineffective action by both the business community and government can no longer be tolerated. The inflationary pressures on the nation's economy with spiraling wage settlements help to intensify one of the nation's major domestic concerns. Because of the direct effect which excessive wage settlements in the construction industry have on other industries, the business community has a vital stake in the resolution of the labor problems in this industry."

In the December 1968 edition of *Fortune* magazine, Thomas O'Hanlon, in an article entitled "The Unchecked Power of the Building Trades," states:

"The role of the building trades, already critical, becomes a matter of major national concern as the construction industry enters a decade of unprecedented demand. Simply to house new families and to replace the normal demolition of old housing units will require the construction of 20 million new dwellings over the next ten years. The expanding population and economy, meanwhile, will require non-residential construction in the form of factories, offices, schools, power plants, roads, and hospitals. Yet there is overwhelming evidence that, if present practices and trends continue, building contractors may be physically unable to meet the demand, let alone maintain any semblance of price stability. Union power aside, local codes inhibit the use of new materials and techniques. Population pressures and land use restrictions are driving up land costs. The cost of money has increased, and most contractors are too small and too poorly organized for efficient operation. Equally important, though, is the fact that excessive wage demands and antiquated union work rules are limiting innovation and raising costs."

Figures 1 and 2 illustrate that wages in construction were in 1969 far ahead of manufacturing.

By the end of 1969, building costs, primarily due to wage settlements, had been rising at the rate of one percent per month. The construction industry, the largest single industry in the country, had a volume of $91.6 billion, which was equal to almost 10 percent of the gross national product. It was larger than the automobile and steel industries combined. The median wage increase in cents per hour in the years 1958 through 1969, is illustrated in Figure 3. In 1969 for all industry excluding construction, a median wage increase of approximately $0.20 per hour was experienced, compared to a construction increase of $0.70 per hour.

In an editorial on July 1, 1969, *The New York Times* stated that construction costs were already so high that unsubsidized apartments could be built only for the rich. Even so, the *Times* argued, present costs would appear

Figure 1 Wages in construction (1969)

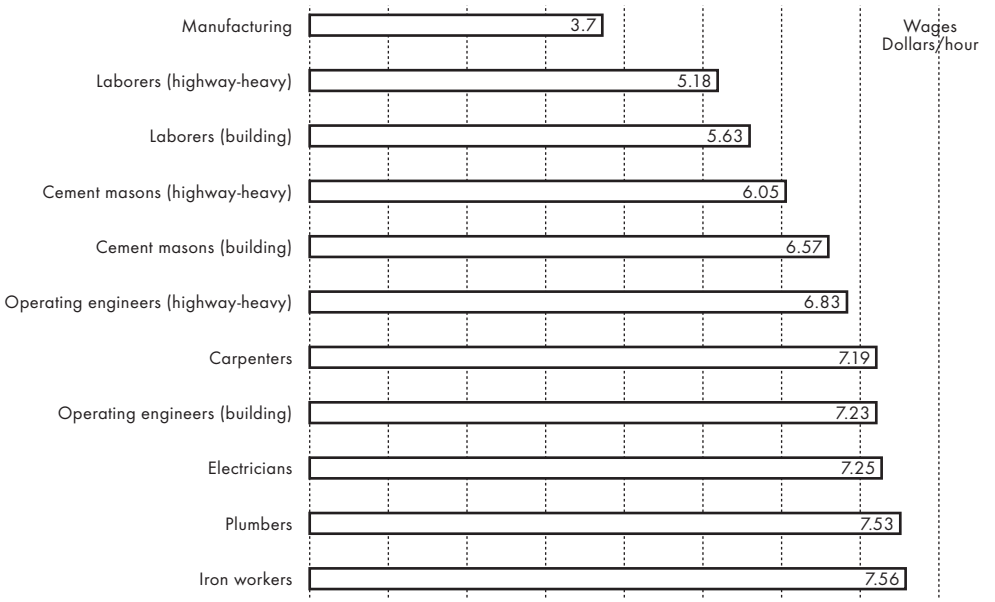


Figure 2 Average wage increase cents/hour (1969)

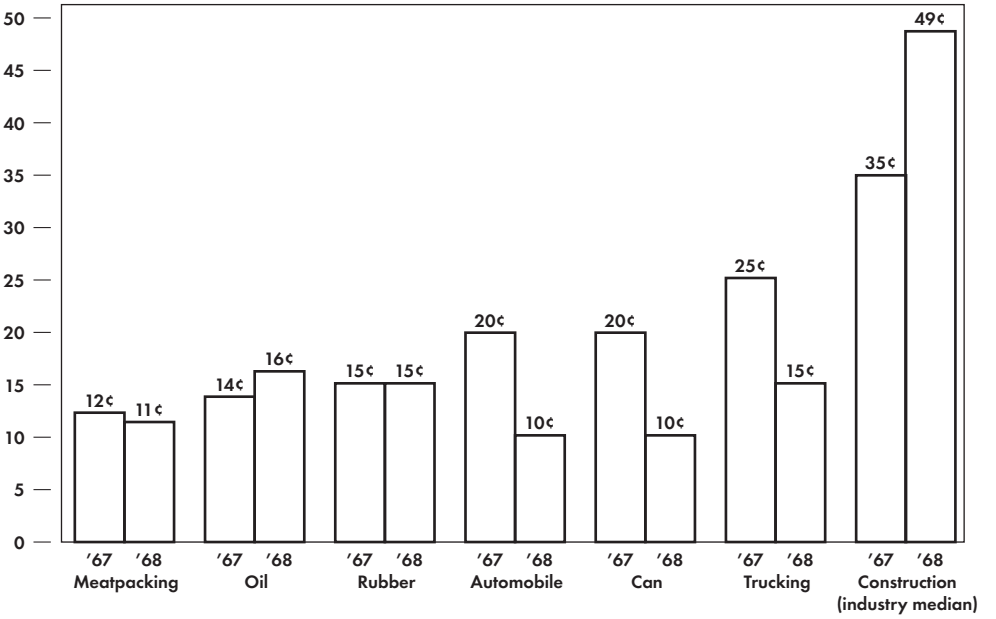
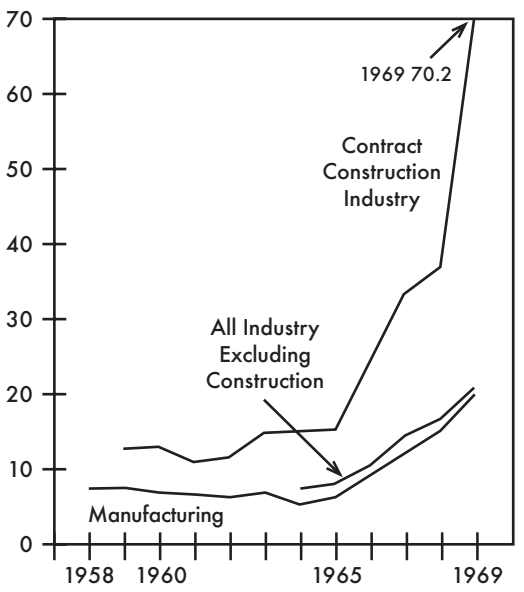


Figure 3 Median wage increase in cents per hour



modest when the public would begin paying for the new agreements in the construction industry, characterizing the settlements (35 to 40 percent over a three-year term) as similar to extortion. The *Times* concluded that the war against inflation had been "put in the deep freeze," and that the dollar would suffer another blow. Wages, however, were only a part of this burgeoning problem. Productivity had declined sharply in the construction industry. In other words, the construction user was getting much less construction for the dollar than before.

It was obvious to the task force formed at the conference in Washington that an owner organization was necessary. In the spring of 1969, a group of several chief executive officers convinced Roger M. Blough that he should lead such an owner organization. Mr. Blough had recently retired as CEO of U.S. Steel. Although reluctant to accept the leadership of this new organization, Blough agreed to do so only if all CEOs present would support the organization and would personally participate. The organization would have a small staff and involve all of the member companies, including their chief executive officers.

The first meeting of the organization was held in New York on June 3, 1969, with representatives from 15 major U.S. corporations. The group adopted the name, Construction Users Anti-Inflation Round Table. Two committees were formed immediately by the owners: a Policy Committee and a Coordinating Committee.

The group quickly recognized the need for contractor advice and input as well, and two contractor committees were formed. The first, the Contractor Advisory Council, was composed of CEOs of large contractor firms and would work principally with the Policy Committee. A second committee, the Contractors Task Force, was made up of construction and labor relations experts who would work closely with the Coordinating Committee.

Among those who shared a growing concern for the industries' problems and contributed to the formation of the Anti-Inflation Round Table were David B. Luckenbill of Shell, Eric R. Miller of Bechtel, Mike Graney of Ebasco, Weldon G. McGlaum of Procter & Gamble, Jack E. Turner of Dow Chemical, and Peter J. Pestillo of the Labor Law Study Committee of

the U.S. Chamber of Commerce.

During the summer of 1969, a series of meetings was held with high-level members of government, including the Attorney General, the Secretary of Labor, the Postmaster General and the Chairman of the Council of Economic Advisors to insure their support and understanding of the Anti-Inflation Round Table. Meetings were also held with George Meaney and Lane Kirkland of the AFL-CIO. By the end of 1969, approximately 70 companies had indicated their desire to become members and to participate, both at the national and local level. Little more than a year had passed since the National Conference on Construction Problems had first brought industry participants together to discuss common problems. The industry was finally taking action. For his efforts, Winton Blount was named the 1969 *Engineering News Record* Man of the Year.

The Anti-Inflation Round Table created task forces to define specific construction industry problems and to recommend appropriate solutions. The following major task forces were formed:

- Restrictive Work Practices
- Overtime
- Manpower Supply
- Restoring Management's Role
- Construction Bargaining
- Jurisdictional Disputes

The Coordinating Committee realized that implementing the recommendations affecting the construction industry would have to take place at the local level where construction is performed and, in particular, where bargaining takes place. Some local construction user organizations had already been developed along the Gulf Coast and in the Pittsburgh, Pennsylvania, area prior to the creation of the Anti-Inflation Round Table. The Round Table encouraged the development of such local organizations throughout the United States. At the end of 1970, some 20 local user councils were in existence, many of which had been helped by the Anti-Inflation Round Table.

The Coordinating Committee met over 60 times from its creation through the middle of 1972. The CEOs had a high level of participation. Unfortunately, there was a relatively low level of activity by the Contractor Advisory Council and by the Contractor Task Force.

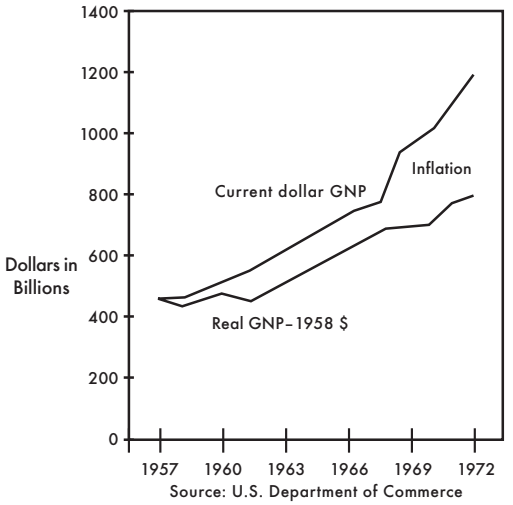
By mid-1972, the Construction Users Anti-Inflation Round Table was recognized as one of the most influential developments in the national effort to come to grips with the problems of the construction industry. The membership in the Anti-Inflation Round Table had reached approximately 120 companies with about one-fourth of these representing electric utility companies. Essentially all of the major companies in the oil, chemical, metals, automobile and rubber industries were Round Table members. The remaining members represented communications, equipment manufacturers, paper, textiles, retailing, defense, glass and building materials. It was clear that the key to success had been the involvement and support of top corporate officials.

Mr. Blough spent a considerable amount of time developing the concept of a contractor organization dedicated to the resolution of the labor relations problems of the industry. His concept was that the organization would be comprised of all types of contractors—general, specialty and national. As a result of his initiatives, the Contractors' Mutual Association (CMA) was formally created with a membership of close to 50 contractors representing all segments of the industry. Unfortunately, there was not a general understanding of CMA's objectives and its proposed method of operation. The Associated General Contractors of America (AGC) advised its members not to join, recommending that they throw their support to breathing new life into the Council of Construction Employers. In late 1975 and early 1976, an effort was made to merge the Council of Construction Employers with the Contractors Mutual Association. This effort foundered, and unfortunately, CMA failed to make a major contribution to the resolution of the problems of the industry.

The Construction Users Anti-Inflation Round Table was not the only organization working to resolve labor management problems. In 1965, an organization known as the Labor Law Study Committee had been created by the U.S. Chamber of Commerce with representation from about 60 major corporations. Its purpose was to address issues whose roots appeared to be in the area of labor law. By late 1972, 39 of the 60 members of the Labor Law Study Committee were also members of the Anti-Inflation Round Table. A number of executives were common to both organizations. Significant advantages would result from combining the activities of the Construction Users Anti-Inflation Round Table, the Labor Law Study Committee, and another group of CEOs called the March Group to improve the ability of American business to promote responsible labor management relations. In a special joint message to the members of the Committee and the Anti-Inflation Round Table in late 1972, W. B. Murphy, retired CEO of Campbell Soup Company and Chairman of the Policy Committee of the Labor Law Study Committee, and Blough submitted to the members of their two organizations a proposal for combining the organizations. The combined organization would preserve the activities of each of the existing organizations. It was planned that the new organization would be called The Business Roundtable. There was concurrence to create this new organization on October 16, 1972.

The Business Roundtable published a statement of its purpose and program on April 4, 1973, which summarized the history associated with its creation. It also reviewed the current economic situation and the status of the U.S. construction industry. Figure 4 depicts the economic progress within the United States from 1957 through 1972, and shows the current dollar GNP compared to real GNP in 1958 dollars. The report also tabulated first-year wage settlements from 1957 through

Figure 4 Economic Progress 1957-1972



1972, illustrating the significant difference between construction wage settlements and all other industries excluding construction.

The two major goals of The Business Roundtable were:

- To enable chief executive officers from different corporations to work together to analyze specific issues affecting the economy and business
- To present government and the public with knowledgeable, timely information and practical, positive suggestions for action.

The structure of The Business Roundtable evolved to include a Policy Committee, Executive Committee, Labor Management Committee, and a Construction Committee. Local User Councils, which were all independent entities, would communicate with and be assisted by the Labor Management Committee and the Construction Committee. The Business Roundtable proposed the following suggestions to improve the effectiveness of the construction industry:

- Become familiar with construction labor relations through Roundtable projects and studies
- Adopt construction contracting policies on:
  - Establishing realistic completion dates
  - Eliminating use of scheduled overtime
  - Supporting contractors in labor negotiations
  - Expanding the construction work force, particularly through the employment of minorities
  - Achieving more efficient construction through the use of helpers and other classifications
  - Removing work restrictions to increase productivity
  - Promoting the contractor's right to manage
- Provide better administration of construction contracts
- Support needed legislative reform
- Make key personnel available for Roundtable special projects
- Consider broad economic impact of construction decisions

The Construction Committee continued its specific construction studies and issued two volumes entitled, "Coming to Grips with Some

Major Problems in the Construction Industry." The following subjects were addressed:

- The hiring hall
- Financing construction association activities
- Jurisdictional problems
- Labor supply
- Scheduled overtime
- Restoration of the management role
- Restrictive work practices
- Contract language between owner and contractor
- The Davis-Bacon Act
- Special building trades agreements

By 1977, the Construction Committee, under the guidance of The Business Roundtable Executive Director-Construction, Richard F. Kibben, had completed a number of studies, and its members were increasingly sensitive to the problems facing the industry. The committee recognized that many problems beyond labor issues involved management of both owner and contractor organizations. The committee concluded that a comprehensive, long-range study of the fundamental problems of the industry should be undertaken, and a task force was established in 1977 to plan and direct such a study. The task force was chaired by Jack E. Turner, Manager-Construction, Dow Chemical USA. Charles D. Brown, General Manager-Engineering, DuPont, became Chairman in 1978. During 1978-1979, the task force accomplished the conceptual planning which resulted in the Construction Industry Cost Effectiveness (CICE) Project.

The CICE Project involved more than 250 people with expertise in construction representing more than 125 companies as well as universities and industry organizations. A total of 23 separate reports were prepared on specific problem areas. The project was to develop a comprehensive definition of the fundamental problems in the construction industry, and produce a program for the resolution of these problems. It was intended that this would lead to improvement in the cost effectiveness of the industry. The study focused primarily on improvement in the industrial, utility, and commercial segments of the industry and was developed from the point of view of users of construction. It was recognized, however, that efforts by all segments of the industry would be necessary if major improvements were to result. The CICE study areas were:

Study Area A: Project Management
Study Area B: Construction Technology
Study Area C: Labor Effectiveness
Study Area D: Labor Supply and Training
Study Area E: Regulations and Codes

As the planning for the CICE Project proceeded, it became apparent that dynamic leadership was needed. At that time, Lieutenant General Carroll H. Dunn (U.S. Army, Retired) was nearing retirement from the Consolidated Edison Company in New York

City. General Dunn, known to many on The Business Roundtable Construction Committee, possessed outstanding qualifications to provide direction and leadership to the CICE effort. When approached, General Dunn accepted this responsibility with enthusiasm and provided astute leadership throughout the period of the CICE study.

The CICE Project produced a total of 223 specific recommendations. The summary report stated that even a modest implementation of its recommendations could save the U.S. construction industry in excess of $10 billion a year. Upon the completion of the project, the network of the Local User Councils was employed to disseminate the results of the study and to garner support for implementation. (The reports continue to be available from The Business Roundtable without cost. About two million copies have been distributed on a worldwide basis.)

The B-3 report of the CICE Project, "Construction Technology Needs and Priorities," recognized that little research had been performed in the U.S. regarding the construction industry, including private and government sectors. The total research relevant to construction was then less than 0.4 percent of the revenues of the industry. This was significantly less than the level of research performed in Western Germany, Japan and the Scandinavian countries. The B-2 report, "Technological Progress in the Construction Industry," recognized that there was no coordinated effort to define the needs for research and development, to communicate these needs to research organizations, to communicate the results of successful research to those who could commercialize them, and finally to furnish the results to those who would apply them. The B-2 report recommended that an organization dedicated to improving the advancement of technology in the U.S. construction industry be identified or established. The report also recommended that owners, in recognition of their stake and influence in the use of research and development, participate in forming and financing the organization and maintain direction and control of its management. In an appendix to the B-2 report, a possible organization to satisfy the recommendations of the study was described. This organization was defined as the National Institute for Technological Advances in Construction (NITAC).

The summary report of CICE, entitled, "More Construction for the Money," was published in January 1983. Many responsible leaders and executives of owner and construction organizations recognized the potential for improvement in the industry as a whole and in their projects from the application of the CICE recommendations. The industry was increasingly aware of the need for a higher level of research and development and the need for an organization to take a leadership role in this effort. The timing was right for the formation of the Construction Industry Institute.

Chapter 3

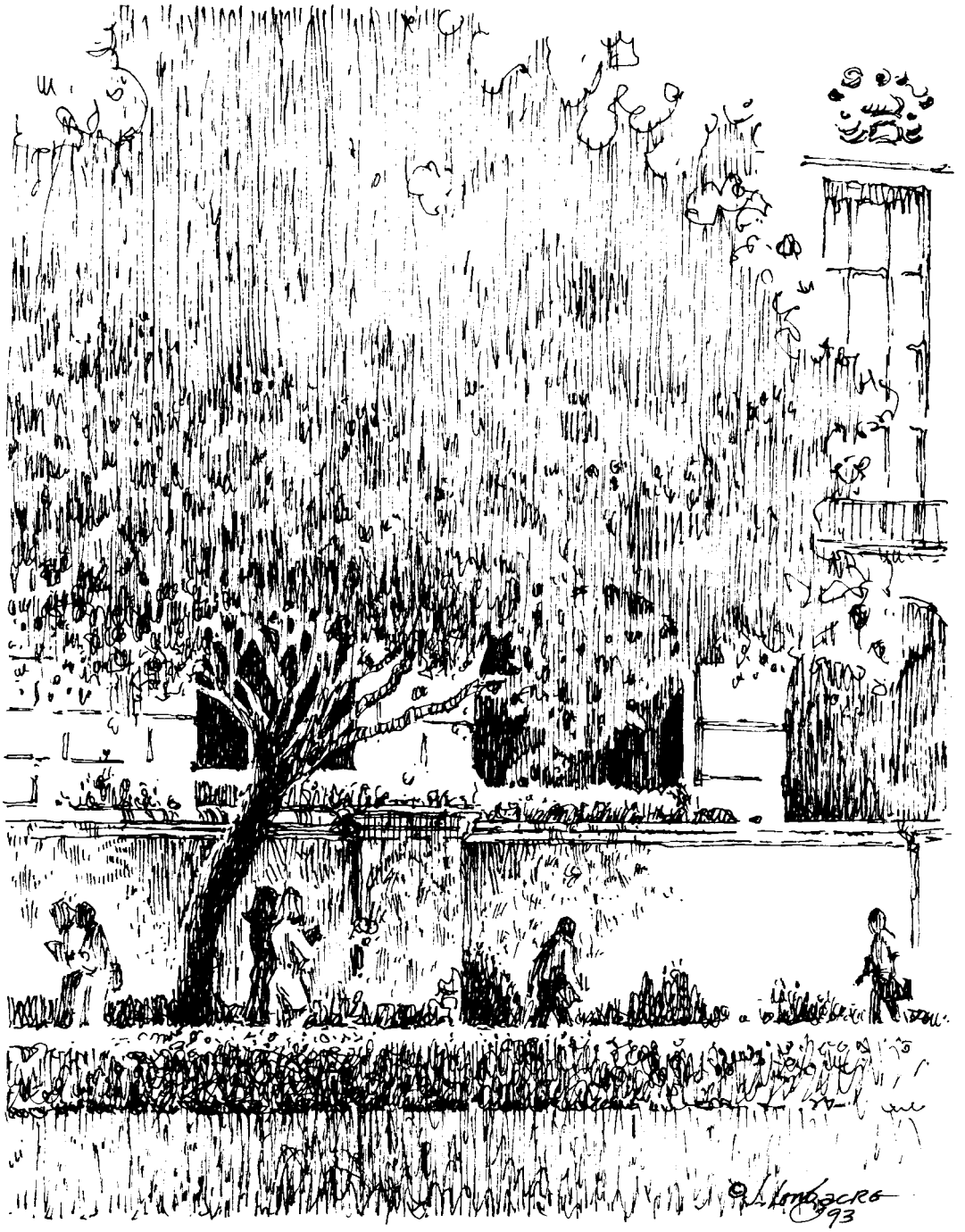
THE EVOLUTION OF CONSTRUCTION EDUCATION AND RESEARCH

Concerns for university-level construction education preceded by many years the concern for the problems described in Chapter 2. In her article, "Pioneering Construction Engineering Education," Bonnie S. Ledbetter traces the origins of significant activity concerning construction education to the decision in June 1934 to create the Civil Engineering Division of the American Society for Engineering Education. This organization itself had been established in 1892 as the Society for Promoting Engineering Education. Shortly after the Civil Engineering Division was created, it was divided into several committees, one of which was a committee on construction engineering. Since this committee closely paralleled a similar committee under the American Society of Civil Engineers (ASCE), a joint committee was established in 1934. Both committees shared the same concerns, and many of the same people belonged to both.

This joint committee conducted a survey of 140 schools to determine the curricula in construction education. Dr. W. C. Huntington of the University of Illinois, chairman of the joint committee, reported in the first issue of the Civil Engineering Division bulletin that a wide variety of practices had been revealed in the survey, but basically four categories had been identified: 1) a special curriculum in construction, 2) a construction option in the regular civil engineering curriculum, 3) elective or required courses in construction, and 4) civil engineering courses which incorporated construction within the standard material.

As Ledbetter states, throughout the decade from 1936-1946, F. H. Kellogg of the University of Mississippi, H. E. Pulver of the University of Wisconsin, and Walter V. Sevoss of MIT insisted that there was a place for construction education in the colleges and universities. Graeme MacDonald, a contractor, Elwood Nettleton, a consulting engineer, and Clark Macomber, an owner of a building construction business, added their support to the movement to teach more about construction in the colleges. Also, a "four-year" construction education program was proposed by Professor Evinger of the University of Nebraska, but these efforts came to naught with the approach of World War II.

Many educators agreed that construction education had been neglected in the nation's colleges and technical schools. This neglect did not seem justified considering the scope of construction activities in the United States. In a 1946 survey, it was determined that the largest division of ASCE was the Construction Division with 25 percent of all members. If



construction was so important to the country, why had it not been incorporated as a valid subject for academic instruction? In December 1947, Professor Clarkson H. Oglesby of Stanford University attributed the neglect to the engineering colleges that had shied away from offering construction education on the assumption that such education could be acquired on the job after graduation. Academics were reluctant to take on even the appearance of training technicians.

After World War II, attention to construction education increased slightly. Along with this, a few forward-thinking contractors recruited graduates informally, taking advantage of faculty contacts. Still, many civil engineers were reluctant to admit that construction was a part of civil engineering. They failed to recognize the great changes that had occurred in construction since the end of the war. Previously, construction operations were predominantly managed by ambitious tradesmen who, by hard work and perseverance, became owners and superintendents. World War II had changed this situation markedly, and the change was continuing at an even faster rate. As the president of one large construction firm said, "Construction is being taken over by professional people—engineers, accountants, and lawyers." Increasingly, graduate engineers were being employed by contractors and then were developed into managers and construction superintendents.

Oglesby observed that two forces contributed to this shift. One, the increasing size and complexity of construction projects that demanded construction supervision of great ability to visualize, analyze, and fit the many fragments into an integrated whole. Second, unionism had clogged the traditional source of construction supervision, skilled tradesmen. The labor force had developed such strong union loyalties that most thought that labor would not make effective members of the management team. Tightened jurisdictional lines also prevented the tradesman from gaining the breadth of knowledge so important to good supervision.

In 1946, Texas A&M University hired Robert L. Peurifoy to develop a construction option in civil engineering. Peurifoy surveyed the curricula in all schools offering construction and found significant variations. Despite the fact that several educators were addressing the need for construction education, only Columbia, MIT, Mississippi, Purdue, Stanford, and Texas A&M offered a construction engineering option by 1947.

The Construction Education Committee was reconstituted in 1948. Among its members were Peurifoy, Kellogg, and Oglesby. They began to examine the lack of appropriate textbooks for teaching construction related topics. Peurifoy later agreed to write texts on "Estimating Construction Costs," which was published in 1953; "Construction Planning, Equipment, and Methods" in 1956; and finally, "Form Work for Concrete Structures" in 1964.

Slow progress was being made in construction education within the U.S. academic com-

munity. Many educators, however, maintained that construction courses were essentially trade school material and not proper subjects for the university. Their argument centered around the question of what should be taught in an academic environment and what should be performed by industry through on-the-job training and in-service training programs.

Professor Oglesby was adamant about the need for construction research as a part of the university educational program. In a paper written with John Fondahl, also of Stanford, "Engineering Education and the Construction Industry," published by ASCE in February 1959, the two develop the point that the construction industry lags far behind those of others in expenditures for research. While highlighting possible subject areas for research, Oglesby noted that:

"Properly directed and programmed research for construction could do much to strengthen today's modest efforts in construction education. Income from research on a continuing basis would permit schools to expand their staffs and to include specialists that they cannot now afford. A combined program of research and teaching, coupled with adequate compensation, could attract able men from industry to teach and to help solve one the most critical problems of the colleges."

Regarding research, Oglesby and Fondahl were speaking from experience. Stanford University, through a series of grants from the U.S. Navy and the National Science Foundation, had an ongoing research program that was considered a pioneering effort in such fields as critical path planning and scheduling, productivity improvement, construction safety and project organization.

The debate over the nature of construction education continued through the 1950s and 1960s. Several proponents explored alternative approaches to incorporate a construction program into existing university curricula. Every engineering curriculum, however, was already a crowded four-year program. If new material were to be added, existing material had to be deleted, but deleting existing material in engineering programs was a considerable risk. Some institutions, such as Cornell University, instituted a five-year curriculum leading to a bachelor's degree in civil engineering. Later, that curriculum was abandoned.

Other approaches to construction education evolved, several in departments such as architecture, engineering technology, construction technology, industrial science and technology, agricultural engineering, and business. In general, these new construction schools focused more attention on construction management and techniques and less on basic science. Ultimately, a trade-off occurred between basic science and practical courses to arrive at a program that now addresses the current needs of the industry.

Today's college level education for construction consists of two quite different four-year curricula, one of which could be considered by industry representatives to be deficient in its coverage of construction manage-

ment and construction techniques, while the other might lack depth in basic science, mathematics, and design. A five-year Master of Science program helps correct both deficiencies, but such programs remain relatively few in number.

The fundamental issues involved in this dilemma were effectively addressed by Professor Oglesby in his acceptance speech for the R. L. Peurifoy Construction Research Award presented in October 1988 at the ASCE Annual Convention. The Peurifoy Award recognizes those educators who have made a major contribution to the areas of civil engineering and construction education and research. Oglesby said:

"The developments leading to the founding and continuation of most of the construction programs have four elements in common. One, a single faculty member or a group of faculty, often with earlier construction experience, who saw a need for and an opportunity to educate students for careers as professionals in construction management. Two, a forward-looking faculty and administration that was willing to acknowledge that introductory courses in construction were a proper subject for professional education. Three, contractors and, in some cases, governmental agencies that were ready and often eager to hire the graduates of such programs. And four, individual construction companies and trade groups that provided financial support for scholarships, research, or faculty positions."

He also quotes Professor Robert W. Dorsey of the University of Cincinnati, who contrasts the orientations of undergraduate construction programs in civil engineering, architecture, and construction science and technology as follows:

"Programs with an engineering base tend to be 1) more academically rigorous, 2) have better access to university resources, 3) have a graduate study/research orientation, 4) are inclusive in admissions, 5) have faculty with little on-the-job experience, and 6) have insufficient space in their curricula for any true construction subjects.

Programs with an architectural base: 1) tend to focus more attention on general education, 2) emphasize the design/construction progression, 3) give an appreciation for contract documents, 4) are limited in scope to buildings, 5) have little research orientation, and 6) are lower in priority in their colleges compared with pure architectural studies.

Construction programs: 1) are less tradition bound than the other two and therefore more flexible in regard to curriculum and course work involving technical applications, 2) are more oriented to hands-on field practice, 3) are more responsive to the requests of industry, 4) have lesser priority in university budgets, 5) do little research, and 6) are staffed with faculty with lesser academic credentials."

Oglesby was also instrumental in developing in-service education for the industry. He recognized that universities are poorly equipped to present even a fraction of the newly developed information to large numbers

of industry personnel. He cited the low level of effort in in-service programs at both the university level and within member companies.

Oglesby was a pioneer in construction education, and provided leadership to bring about change. He knew that many participants in both industry and academia viewed construction engineering as something that was learned on the job, not in the classroom. He disagreed and persisted in changing that view. His influence undoubtedly shaped the future of construction education. He is widely recognized as an eminent authority and an innovator. Because of this and his exemplary record of accomplishments, CII awarded Oglesby the Carroll H. Dunn Award of Excellence, the Institute's highest honor, in 1991. His death a year later at the age of 83 was a loss to all who knew him.

During 1962, Dr. Richard L. Tucker, another educator with a background in structures and geotechnical engineering, began teaching in the Civil Engineering Department at The University of Texas at Arlington. Tucker was appointed as UT-Arlington's Associate Dean of Engineering in 1967 with responsibilities to develop a graduate program and a research program at that university. In pursuit of these objectives, Tucker established the Construction Research Center, an organization which remains in existence. The center invited people interested in the construction industry from the Dallas/Fort Worth area to join for $1,000 a year. This would provide research funds in the $20,000 to $30,000 range.

After approximately two years of operation of the Construction Research Council, one of the companies of the organization offered Tucker a position as vice president for research. He left UT-Arlington for approximately two years. During this time he became involved in the Associated General Contractors (AGC) Education and Research Foundation Advisory Council. One of the members of this council was retired General Carroll H. Dunn, who was then Vice President of the Consolidated Edison Company of New York. Another member of the council was Professor J. Neils Thompson, who was a faculty member at The University of Texas at Austin. The three worked together in an effort to establish a major research effort within AGC. This effort ultimately failed and the council was disbanded.

When it became clear that the council was not going to be successful, Thompson advised Tucker that UT-Austin was interested in hiring a faculty member to take the leadership of its construction education program. As a result, Tucker joined the UT-Austin faculty in 1976 and continued to pursue the subject of construction research. He visited a large number of companies in Texas to generate support for construction research programs, but the uniform answer was "no" for two reasons: 1) companies did not think that the academic community knew enough about the construction industry to make a meaningful contribution, and 2) a confidentiality issue existed.

Ultimately, Tucker's contacts with industry

led to a consulting assignment for The Procter & Gamble Company. Another researcher on the project was Dr. John D. Borcherding, also a member of the UT-Austin faculty. Procter & Gamble wanted to improve productivity on one of their projects. At that point, only small efforts had been made in the area of productivity improvement in the U.S. construction industry. The Procter & Gamble program proved to be successful. At a cost of $20,000, the company claimed the program provided them with cost savings nearing $200,000. Tucker gained recognition for his role in productivity improvement and for the development of the construction faculty at UT-Austin. This ultimately resulted in a request from Texaco to work on a major project at Pembroke in Wales, United Kingdom.

By mid-1979, Louis Garbrecht, General Manager of Corporate Engineering for Texaco, recognized that improving the productivity on the Pembroke project was paramount. The project had been funded by a partnership between Texaco and Gulf Oil. The Italian firm, Snamprogetti, was the prime contractor. This arrangement generated some adverse reaction by the United Kingdom labor force.

Since Texaco was the managing partner, Garbrecht commissioned Kenneth E. Hamilton of Texaco to conduct a survey of consultants who were available to help with the project. This survey led to Tucker's selection to assist the project team. Notable improvements resulted on the project, and subsequently, Garbrecht requested that Tucker work with Texaco, Brown & Root, and Fluor on a large project in Louisiana as a follow-on to the effort in the United Kingdom. At that time, Texaco had approximately $4 billion of construction planned. Improvement in project planning and execution was critical. Tucker proposed in this particular instance that the research project be done through UT-Austin. The university research effort lasted five years and produced a significant number of beneficial results.

As his interest in productivity improvement grew, Tucker initiated the Construction Productivity Improvement (CPI) Conference, which was conducted at UT-Austin in 1979. Representatives from owner and contractor organizations were invited to pool their resources to identify good practices in the industry.

When the summary report of the CICE Project, "More Construction for the Money," was published in January 1983, significant progress had been made in the area of construction education with major programs in place at Stanford, Purdue, UT-Austin, MIT, Georgia Tech, California-Berkeley, Clemson, Illinois, Michigan, and North Carolina State. Trained construction professionals were graduating, and owners and contractors were prepared to employ them on their projects. This clearly created a sound foundation for ultimate improvement in the cost effectiveness and productivity of the industry.

Unfortunately, little construction research was being performed at universities or else-

where in the United States. As of 1982, less than 0.4 percent of the total volume of the industry was being spent for construction research. By the time the CICE project recommended that some kind of organization be established to pursue construction research in the U.S., many owners and contractors had become more aware of the potential benefits to be gained from enhanced construction education and research. The academic community was eager to participate in this kind of effort. Richard Tucker, as chairman of the ASCE Construction Research Council, was well aware of the academic community's interest and its capabilities. Thus, the stage was set for an initiative to create a research organization. The history of the creation and evolution of the Construction Industry Institute will be treated in the following chapters.

Chapter 4

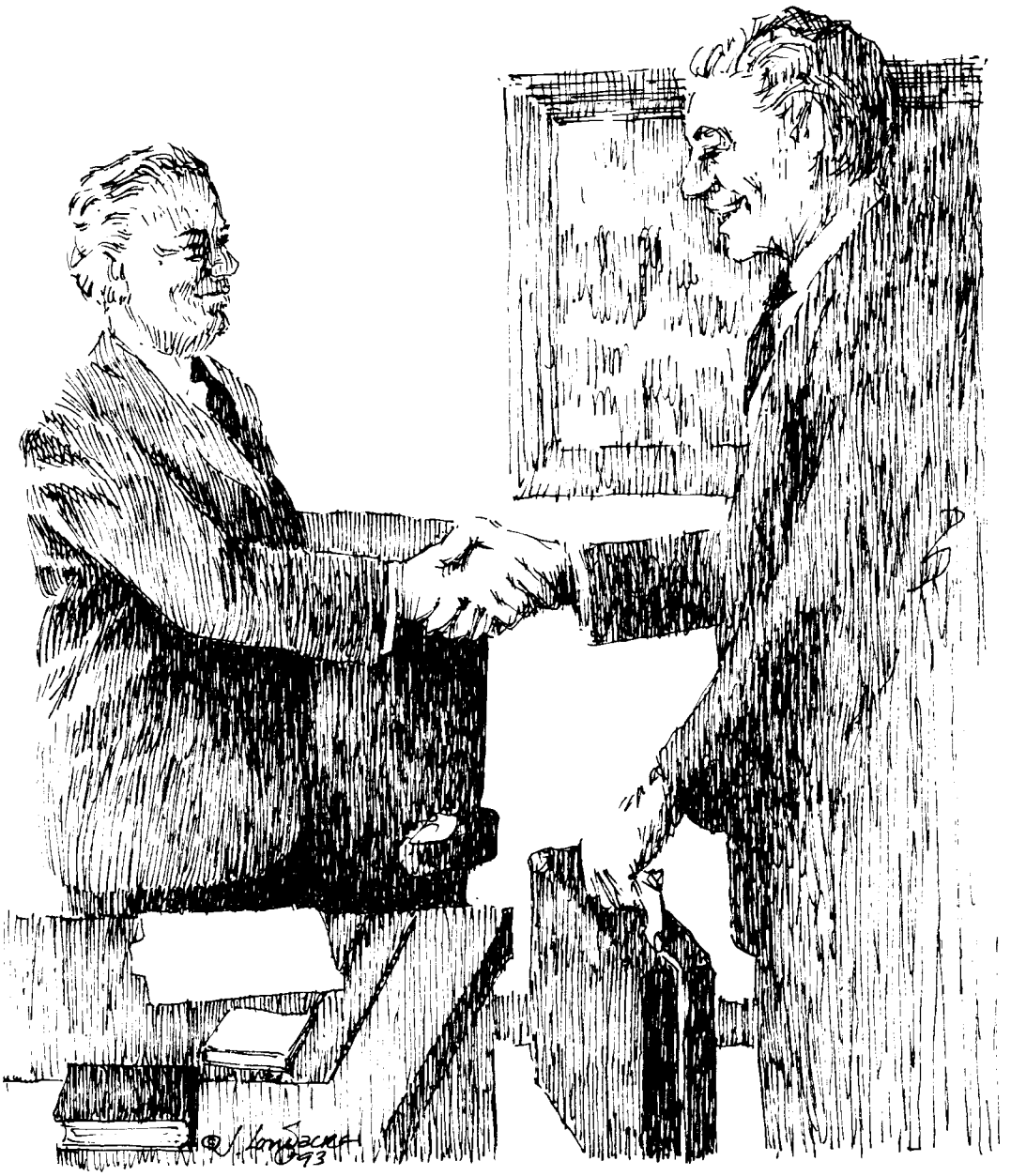
THE CREATION OF CII

At the Construction Productivity Improvement Conference in September 1982, Arnold Smith, Manager of Project Engineering of Texaco, spoke of the results of the UT-Austin research efforts on the Texaco project in Louisiana, and told conference participants that significant benefits had been realized by Texaco. He said that the industry as a whole could gain if several major companies would pool their resources and perform research that would improve project cost effectiveness. While this suggestion sparked interest, no immediate action occurred in pursuit of the idea. Richard Tucker, however, thought that the concept had considerable merit. He felt a much higher level of research was needed in the industry than had been experienced.

In October 1982, Tucker met with Texaco's Louis Garbrecht to discuss a plan by which several companies would explore the potential for the creation of a construction industry research organization. Their strategy called for a meeting that would include Carroll Dunn and other people from The Business Roundtable CICE Project. Tucker had written most of the CICE Project B-3 report, "Construction Technology Needs and Priorities." He also had maintained a close dialogue with General Dunn, Executive Director of the CICE Project. Invitation letters were sent to a large number of companies and individuals, most being well known to either Garbrecht or Tucker. Earnest F. Gloyna, the Dean of Engineering at UT-Austin, was invited as were other representatives from UT-Austin.

Many people at this meeting, which was conducted on February 2, 1983, were skeptical. Some were not sure that university professors or graduate students could contribute to the industry. Others felt no need to improve. One representative made the distinction between benefactors and beneficiaries, saying that most of the companies participating in the meeting were so sophisticated that the only product a new organization would be able to provide was information that the industry already had.

Garbrecht described the Texaco Engineering Department as having been historically oriented toward small lump-sum, turnkey projects. A great need existed, however, for the application of basic management principles to improve the planning, motivation, control, and communications in larger and more complex projects that were to be forthcoming. Citing the successful relationship that had evolved between Texaco and the UT-



Austin faculty, Garbrecht argued for an expanded effort—an effort that was beyond the scope of any single company. There was, he said, significant potential for improvements to the industry as a whole if major stakeholders in the industry would work toward the common goal of improvement.

Dean Gloyna indicated the strong commitment of the University to the construction and project management area and described UT-Austin's Bureau of Engineering Research, which could administer an industry research organization. The Dean's Office, he said, would back the creation of such an organization.

General Dunn indicated that there was nothing in Garbrecht's proposal that would conflict with the recommendations of the CICE study. He foresaw a tremendous opportunity for gains and recommended that the group act immediately. Dunn indicated that The Business Roundtable was not in a position to say where such a center should be developed. He maintained, however, that the need for such a center was paramount.

Daniel J. Bennet, then Executive Director of The Houston Business Roundtable, spoke of the activities of that Local User Council. The Houston group, Bennet said, had 14 committees at the time that were looking at various CICE recommendations. He felt the proposed research center would be useful particularly because of the current workload in the Houston area and the large number of owner and contractors that could participate in the research activities.

Although the meeting was exploratory in nature, some of the scope of activities of the center that were discussed are listed below:

- Data (depository, analysis, information, and retrieval)
- Research
- Standards
- Interface relations
- Conferences
- Publications
- Continuing education
- Informal education

Several at the meeting spoke of the need for identifying more specific goals and activities. Particular interest was expressed for research on planning methods. Other suggested topics included productivity measurement, impact of early decisions, communications, and management systems. Some participants suggested the possibility of regional centers with differing scopes of activities.

The attendees agreed in principle that the concept of the center had significant merit and would be consistent not only with the recommendations of the CICE Project, but with their individual company interests. Garbrecht appointed a committee that included himself, Norbert Buchsbaum of Gulf Oil, Robert Hukill of Sun Oil and The Business Roundtable, Charles Collyer of Bechtel, Alvin Kirk of The Lummus Company, Norman Maultsby of Daniel, and Tucker of UT-Austin. The committee was to refine the ideas and develop a concept statement that would be

presented to the entire group.

During 1983 and well into 1984, the concept of NITAC as expressed in the CICE B-2 report was being pursued separately. A construction research and development committee, known as the B-2 Committee, then chaired by Robert McCutchen of Caterpillar Tractor, addressed the potential for the establishment of NITAC. This committee concurred that NITAC was a sound concept. The functions defined in the B-2 report were considered appropriate for such an organization. These functions included the following:

- Defining the industry needs for research and development.
- Communicating these needs to the research and development community.
- Communicating the results of successful R&D programs to owners and potential users of construction technology.

The Garbrecht subcommittee soon produced a report for further consideration by the companies expressing an interest in creating an industry research center. Leaving the ultimate name open for the time being, the group proposed the purpose statement for the new organization: "The purpose of the center is to develop and disseminate meaningful knowledge to enhance the management and execution of engineering and construction projects." The mission was stated as: "The principal mission of the center is to provide a vehicle for merging the information and ideas from owners, contractors, and others with academic resources and to develop needed techniques and databases."

A basic structure was proposed to include a Director, who would be well acquainted with academic programs and research, and who also would be responsible for leadership and administration of the center. The committee also proposed an Advisory Board of Directors composed of representatives of member companies and a Policy Committee that would advise the Director on the center's goals and objectives, program development, contract administration, budget, and personnel matters. It was recognized that as the center developed, a limited research and technical support staff would be employed to provide research program stability and administrative services.

Several issues had the potential for discouraging companies from membership in the new organization. Concerns for anti-trust statutes had been raised by several companies as had the confidentiality of information. It was the subcommittee's view that locating the organization at a university was at least a partial solution to these questions.

It was proposed that potential subject areas for future research would be generated by the membership, faculty, the center staff, and others who had an inherent interest in construction research. The center would accept recommendations from virtually any source in order to assure that the research program was relevant to industry needs. A methodology also was proposed for developing priorities among the research topics and for reviews of the scope and

budget for proposed studies by the Advisory Board of Directors. Two levels of membership, first sustaining memberships at $25,000 and then second, members at $10,000 a year, were also planned. The concept for the lower annual dues would be to permit membership to be available to smaller companies, but this category would have a reduced role in the operation of the center. The contributions of experienced people by member companies, it was felt, would be of greater value than the financial support. An initial budget was estimated at $200,000 to cover salaries, travel, computer time, printing, and administrative expenses.

A draft proposal was distributed to the original committee. Two unique features of the center were highlighted: first, principal funding would come from sustaining memberships; and second, significant participation by the membership would be required in the center's activities.

On April 21, 1983, the ad hoc committee again met under the leadership of Louis Garbrecht. The group suggested several changes for incorporation into a revised concept paper. The issue of the name of the research center remained open. The committee felt, however, that the center should be initiated as soon as possible. It was suggested that the CICE Project Task Force of The Business Roundtable's Construction Committee should endorse the establishment of the center.

A driving question at these early meetings was, "Where should this new organization be established?" Several universities had strong construction and construction management programs; some already had research organizations in place. The argument to develop this organization at UT-Austin was reviewed in detail. Of particular significance was the momentum that existed at that time, both in terms of the creation of this specific organization and the momentum involved in the successful efforts involving Texaco. The faculty at UT, in addition to its strong reputation, had a history of involvement in major projects. The faculty had been involved in three of the CICE Project reports.

The leadership role of the UT-Austin faculty was also recognized as a significant factor. Tucker was chairing the ASCE Construction Research Council and was an active member of the Civil Engineering Advisory Committee of the National Science Foundation. John Borcherding, who had worked with Tucker on the Procter & Gamble productivity improvement project, was the chairman of the ASCE Construction Labor Committee. UT-Austin itself could provide a strong support service base for the center with other UT colleges, including Business, Architecture, and Law. A substantial body of graduate students was busy at UT-Austin as well: approximately 50 students were involved in masters and doctoral programs in construction. After considering these qualifications, the ad hoc committee concurred that it would be desirable to pursue the potential for establishing the construction industry research center at UT-Austin.

In order to assure a common understanding between those working with the industry com-

mittee and the University administration, a luncheon was scheduled between Louis Garbrecht and Dr. Gerhard J. Fonken, Executive Vice President (and now Provost) of UT-Austin. At this time, the new organization was tentatively titled the Institute for Enhancement of Engineering and Construction Projects. Dr. Fonken was briefed on the activities to date of the committee, and Garbrecht advised him of the strong support in industry for the creation of this organization at the University. Garbrecht indicated that a further meeting would be conducted in June with the expectation of receiving firm commitments from a significant number of companies with respect to membership and their willingness to fund the Institute beginning January 1, 1984. Garbrecht felt that it was now appropriate to begin the formal process for proposing its establishment. Dr. Tucker initiated this with a specific proposal that was submitted to the Associate Dean for Research & Planning on July 5, 1983.

The third meeting of the industry group was held in Houston on July 28, 1983. Garbrecht was unable to attend, and leadership for this meeting was provided by Tucker and Robert H. Miller of DuPont . They reviewed the history of the concept for the Institute and the circumstances under which the companies had been invited to consider a charter membership. The need for, purpose of, and possible functions of the Institute were summarized. Those in attendance agreed that something needed to happen, and that it would be unthinkable not to have a central point to bring things together. An agreement was reached that the Institute would not accomplish miracles overnight, and that participants should not justify their memberships on a rapid return on investment. It was felt that the major benefit of the Institute would be to provide a single national forum for the engineering and construction industry to bring owners, contractors, and universities together in a coordinated effort to advance the industry.

While many of the details of the organization and the procedures remained to be defined and clarified, the basic structure as proposed by the committee was reviewed and an anticipated schedule for establishing the Institute was suggested, with the hope that operations could begin on January 1, 1984. This, of course, would be dependent on funding commitments by member companies. To assure diversity of membership, it was suggested that the power and building segments of the industry be invited to join. Following this meeting, contacts were made with the Construction Committee of Edison Electric Institute (EEI) and with the Electric Power Research Institute (EPRI).

Anticipating UT-Austin approval, it was decided to conduct the first meeting of the Advisory Board of Directors at the Denver Marriott Hotel on August 24, 1983. This meeting was held in conjunction with an annual meeting of the Engineering and Construction Contracting (ECC) Division of the American Institute of Chemical Engineers (AIChE).

Many of the participants in the ECC meeting would also participate in this first meeting of the Institute. At this time, several alternative names were considered, and the leadership of the group believed it would be most appropriate to call the organization the National Construction Industry Institute.

Tucker opened the meeting by giving a brief background and history of how the idea for a research institute for construction came into being and emphasized that its primary purpose would be to benefit industry. He suggested that the Advisory Board name a chairman for the Institute from industry who would then conduct the remainder of the meeting. Louis Garbrecht was nominated and elected unanimously. Two committees were formed: an Executive Committee and a Membership Committee. The Executive Committee would address the large number of administrative details concerning the structure and operations of the Institute and would establish effective working relationships with UT-Austin. The Membership Committee, chaired by Peter Forster of Blount, was established to seek a more extensive and diverse membership for the Institute. It was agreed at this point that owner commitment was essential for the Institute to succeed. General Dunn specifically encouraged all members of the Advisory Board to actively participate. It was agreed that the next meeting of the Advisory Board of Directors would be on October 27, 1983, in Austin.

The Executive Committee met with Dr. Peter T. Flawn, President of The University of Texas at Austin, on October 26, the day before the next scheduled meeting of the Advisory Board of Directors. Flawn requested the word "National" not be included in the Institute's name for the time being since the University did not want to unilaterally create a national organization prior to its proving itself. President Flawn enthusiastically supported the Institute and agreed to recommend to the Board of Regents that the Construction Industry Institute (CII) be established at The University of Texas at Austin.

Dean Gloyna opened the October 27, 1983, meeting by emphasizing his support for the Institute and expressing appreciation to those who showed their interest by their attendance and by their previous commitments. Miller of DuPont and General Dunn reported on the meeting with President Flawn. Richard Tucker advised that it would be necessary to change the name of the Advisory Board and the Advisory Councils to avoid a University regulation which limits the number of members on advisory boards and councils to 25. These groups would now be called the Board of Advisors and Advisory Committees. Pete Forster of the Membership Committee requested that all members send names of potential new members to him. He also discussed how the Institute could involve other organizations, such as the Edison Electric Institute and its efforts. Robert Goodson, representing the Construction Committee of EEI, spoke in support of a continuing dialogue and cooperative effort between EEI and the Institute.

During these early meetings of the Board of Advisors, it was critical that the concepts for the operation of CII be thought through carefully. Both Arnold Jones of IBM and Keith Price of Morrison Knudsen served as "devil's advocates" by challenging policies and procedures that appeared to them to have potential for long-term problems. This was beneficial and assured that CII would evolve in a careful, deliberate way.

Jack J. Agresti of Guy F. Atkinson Company of California told the committee of a proposed construction executive program at Stanford University that would be a six-week program designed for high potential employees. Attendees would usually be 35 to 45 years old with a varied engineering and construction background. It was proposed that this program ultimately would be available to other universities following its initial offering at Stanford. A decision was made to support creation of this program with an appropriation of $50,000.

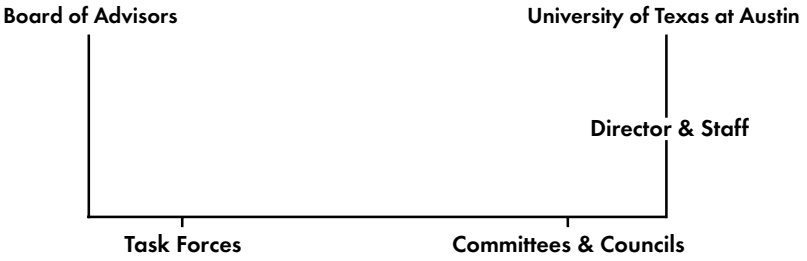
Robert Hukill, then a consultant to The Business Roundtable, reported on the work of the NITAC Working Committee chaired by Mr. McCutchen of Caterpillar Tractor. It was agreed that representatives of this committee would be invited to discuss NITAC at the December 8th CII Board of Advisors meeting.

The following day, on October 28, 1983, Dean Gloyna advised that The University of Texas at Austin had formally approved the establishment of the Construction Industry Institute. CII would be part of the College of Engineering's Bureau of Engineering Research.

A dream had become reality. In approximately eight months—from the time of the initial meeting in Houston on February 2 to the formal establishment of CII at the University of Texas at Austin on October 28, 1983—the concept for a construction research organization had been explored by representatives from a variety of both owner and contractor companies. The idea had been supported by the Construction Committee of The Business Roundtable, and ultimately was approved by the potential members of the Institute and the administration of The University of Texas at Austin. The days immediately following this formal approval were hectic at the initial offices of CII as preparations were made for active operations to begin January 1, 1984.

The Board of Advisors met once more in 1983. The meeting was held in San Francisco, California, on December 8, and was hosted by Guy F. Atkinson Company. At this point, 28 member companies composed CII (see Appendix A). Pete Forster proposed a set of membership by-laws, providing that membership applications would be approved by the Membership Committee and referred to the Executive Committee for final action and invitation to membership. Membership would have a two-fold responsibility: financial support and active, meaningful participation by qualified management personnel. At this point, it was concurred that there would be only one class of membership with annual dues of $25,000. The proposed budget for 1984 was reviewed by the committee and approved.

Figure 5 CII Structure 1984



Richard Tucker reported that on February 20-21, 1984, the National Science Foundation would hold a workshop in Austin to discuss the nature of the NSF research activities in the construction area. Robert McCutchen gave an update on NITAC and made the point that NITAC was still a concept rather than an organization. He emphasized that several activities could prove beneficial if undertaken, including identifying industry needs and making these needs known, visualizing applications of new technology, and accelerating the exploitation and transfer of technology.

It was agreed during the early part of 1984 to create a Strategic Planning Committee for CII under the chairmanship of Robert Miller of DuPont. This committee would review the long-range goals of the Institute and propose a structure that would be appropriate for supporting these goals. The early structure of CII is shown in Figure 5.

As CII entered its first year of operation in 1984, participants on the Board of Advisors showed a high level of enthusiasm and interest. The original members had succeeded in laying a strong foundation for a national forum that would bring the industry together: to improve cost effectiveness. Industry and academia also had forged a link to provide research vital to achieving the Institute's mission. The research program of the Construction Industry Institute would prove to be the success story that helped to update and unite an archaic and fragmented industry.

Chapter 5

THE CII RESEARCH PROGRAM

The Construction Industry Institute was conceived as a research organization that would be member-driven and responsive to the needs of its membership. The CII research program is defined as "top-down," with the membership of CII determining the research to be performed. From the beginning, it was intended that the representatives of the member companies participating on the Board of Advisors would authorize research topics.

The subject of the research program was a major topic on the agenda of the first meeting of the Board conducted in Denver on August 14, 1983. This meeting preceded the formal approval by UT-Austin of the establishment of CII. Richard Tucker presented several possible research subjects to the Board for consideration:

- CICE Implementation Effectiveness
- Schedule Effectiveness
- Progress Measurement
- Productivity Measurement (site and engineering)
- Quality Assurance and Quality Control
- Materials Management
- Standardized Terminology
- Construction Education
- Data
- Subcontractor Effectiveness
- Organization and management structures (owner involvement in the construction process)
- Feedback—design and project critique
- Constructability and preassembly
- Safety
- Standardized design and installation benefits
- Risk and decision analysis

Member companies were requested to submit proposals for research topics either from this listing or others that they might generate themselves. The proposals would be sent to Tucker by October 1, 1983, with each member company limiting the number of its proposals to no more than three. The Executive Committee would then correlate the proposals and present them for preliminary screening at the October 27 meeting of the Board. The final decisions would be made during the meeting scheduled for December 8, 1983. It was clear that the Board intended to move out rapidly in initiating the CII research program. The number of topics to be studied would be a function of the resources available in the 1984 CII budget, which would depend upon the level of the CII membership.

During the October 27th meeting, Tucker reviewed the results of the study topics balloting by the members. The six subjects receiving the most votes in order of preference are listed below. In addition, a data activity was established, making a total of seven initial research areas.

- Evaluate the Impact of the CICE Recommendations
- Site Productivity Measurement
- Constructability
- Contract Roles and Risk Allocation
- Control Systems
- Materials Management

Tucker agreed to begin the process of forming advisory committees and requested members to submit nominees for consideration at the next Board of Advisors meeting scheduled for December 8, 1983.

During that meeting, Tucker reviewed the planned advisory committees and how they would function. More individuals had been nominated to participate on advisory committees than were required; therefore, it was agreed that the Executive Committee would make appointments, with one or two qualified faculty members from various universities serving on each. To provide direction and guidance to the initial set of advisory committees, each would have a representative from the Executive Committee appointed for liaison. The appointments were as follows:

- Data: Jack Agresti, Guy F. Atkinson Company of California
- CICE Impact Evaluation: Louis Garbrecht, Texaco
- Productivity Measurement: Keith Dodson, Brown & Root
- Constructability: Robert Maass, Exxon
- Contractual Roles: Arnold Jones, IBM
- Cost/Schedule Controls: Keith Price, Morrison Knudsen
- Materials Management: Robert Miller, DuPont

The Executive Committee developed the membership for these original "advisory committees" (later called task forces) and appointed the chairmen for each. The task forces were given a broad charter with the freedom to define the specific focus of the studies they would recommend. The chairman of each task force was requested to report back to the Executive Committee and the Board when their deliberations had proceeded to the point where they were prepared to propose specific research projects and request funding for them.

At this time, CII was a young and growing organization. Its purpose and mission were clear. Its methods for operating were evolving, which became apparent as the first task forces made presentations to the Executive Committee and the Board. Few task force chairmen escaped these meetings unscathed. The membership held diverse viewpoints with respect to the nature of the studies that should be performed under each of the task forces. As chairmen presented proposals for research, strong disagreements among the Executive

Committee concerning the proposals were common. The task force chairmen often were requested to reconvene the task forces and re-evaluate their proposed projects.

This was a frustrating experience for many task force members, who expressed the view that it would be more appropriate for the Board to provide a more specific and detailed scope of work for the task forces. While some degree of inefficiency was built into this process, the ultimate results of the work of the original task forces confirmed that the process was effective. The debates within the task forces and among the Board representatives helped to sort out priorities and assured a broad consensus among the membership: CII research would be relevant to the needs of the industry.

Each task force developed its own individual working methodology. Within the general guidance provided by the liaison members of the Executive Committee, each task force also set its own schedule and modus operandi. Generally, a task force would meet for two days approximately every two to three months. The meetings were held in various geographical locations, with one meeting held in Austin each year so that the members of the task forces would gain some familiarity with the offices and staff of CII. In most cases, member companies hosted the meetings and provided conference facilities.

In virtually every case, task force members had not known each other prior to the first meeting. Representatives from owner and contractor firms were on each task force. Although initially reluctant to share their knowledge and experience openly, this reticence subsided within a very short time. In fact, after a second task force meeting, representatives from both owner and contractor firms were identifying themselves more as members of a particular task force than as representatives of individual companies. Thus, task force loyalties evolved quickly and the distinction between owner and contractor tended to disappear.

The role of academics, on the other hand, evolved rather slowly with widely varying experiences. In some cases, academic members were aggressive and proposed research topics during the early stages of the operations of a task force. In most cases, however, academics were recognized as knowledgeable and experienced resources who could contribute to the definition of problems and the development of a long-term research program for each task force. The second approach proved most effective, and academics became an integral part of the operations of the task forces.

As the original task forces submitted their proposals and received funding for specific research projects, a methodology evolved for accomplishing projects at the various universities. During this time, Fred Friedrich joined the CII staff as Technical Director to provide support and guidance to the task forces and, in particular, to support the administration of the contracting program between UT-Austin and other universities. When a university was

selected to accomplish research under the direction of a task force, a contract was issued from UT-Austin to that university. The contract was administered by CII with overall program management provided by the task forces.

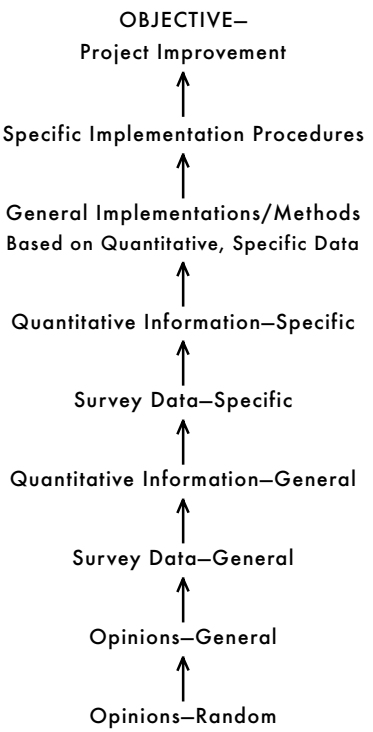
The task forces remained closely involved with the work of the academics during the research projects. In some cases, geographical subcommittees were established to work closely with the research teams. Each research team consisted of a faculty member and one or more graduate students. While in most cases the faculty member performing the research was a member of the task force, this was not a requirement. It was considered entirely appropriate for one academic to be a member of a task force while the research was performed by a different academic at a different university.

Progress reports were made at the various task force meetings so that the task force members would be aware of the status of the work. Friedrich attended many task force meetings to assure that the administration of the research program was proceeding effectively and to be certain that the CII staff was providing appropriate support to the task forces.

In order to define the character of the research program considered appropriate for CII, Tucker developed a graphical portrayal of a research hierarchy, which is set forth in Figure 6. His purpose was to place in perspective the role of organized research as compared to organized opinion. If CII were to produce a series of reports that reflected only the personal knowledge and experience of a small number of people serving on a task force, Tucker argued, this would not necessarily represent the best possible information on the subject. It could represent, he said, a biased viewpoint being influenced to a significant degree by a small number of people.

As the research process evolved among the initial task forces, Tucker was looking forward to further increments of research. The membership of CII was growing and additional resources were becoming available. At the Board of Advisors meeting on February 23, 1984, Tucker provided a list of National Science Foundation (NSF) research project priorities that had resulted from an NSF workshop held earlier in Austin. After reviewing the

Figure 6 CII Research Hierarchy



list, the Board decided to create a Design Task Force with Robert H. Miller of DuPont assigned as Executive Committee liaison.

At the Board of Advisors meeting conducted on May 24, 1984, in Boise, Idaho, Robert Maass of Exxon reviewed the recent activities of the CICE Project B-2 team with regard to the formation of NITAC. The committee had explored several alternative ways of achieving the goals of NITAC as recommended in the B-2 report. The committee, Maass said, recommended that the mechanism for implementation of NITAC move from the CICE Task Force to CII. This recommendation had been accepted by the CICE Task Force.

Maass also reported that the Executive Committee had recommended that a CII Technology Task Force be established. The Board concurred. This task force would: (1) identify present construction technology development and assist in communication with others; (2) define construction research by others; (3) sponsor construction research by others; and (4) provide linkage between researchers and users. These purposes were quite similar to those originally recommended for NITAC in the CICE B-2 report. As the work of this task force proceeded, not all of the recommended functions would be performed. The basic thrust of the B-2 report, however, had been implemented.

In 1985, with 10 task forces functioning (a tenth task force, Quality Mangement, had been added), it became obvious that significant coordination was required. While some duplication of effort was considered appropriate and healthy, it was also desirable for the task force chairmen to communicate with one another on a periodic basis. Thus, Friedrich convened the first Task Force Chairmen's meeting in 1985 to achieve this purpose. These meetings have continued on a regular basis.

As the number of task forces increased, it also became apparent that some structure would be required in the process for determining future research. One major problem was the significant number of Board of Advisors representatives who were attending a Board meeting for the first time. The problem resulted both from turnover of positions in member companies and from new members of CII. Given this situation, it was difficult for Board members to fully appreciate the nature of the research program already under way when considering new topics for future research.

One partial solution to this was to present a new member briefing before each Board meeting so that people who were participating for the first time could be given a basic orientation on CII and its research program. This was only a small step, however, toward resolving the problem of the knowledge and experience level of the Board members as they were asked to vote on new research subjects. In 1993, a booklet on CII board member responsibilities, organizational structure, and the annual cycle was prepared by the CII staff, as well as a similar book on Executive Committee responsibilities.

In May 1987, Friedrich left the CII staff for an appointment with the Texas Department of

Transportation. In August of that year, Charles I. (Chuck) McGinnis joined the staff as Friedrich's replacement and was appointed Associate Director. McGinnis had recently retired as Executive Vice President of CII member company Fru-Con in St. Louis, Missouri. He had served as a member of both the CII Board of Advisors and the CII Executive Committee. Well known to Tucker and others within the organization, McGinnis had a sound knowledge of the operations of CII. One of his early efforts was formalizing the process for research topic approval and funding.

The process that McGinnis developed can be summarized briefly. The Board, when voting to establish a new task force, would identify a research subject area. A purpose for the task force would be prepared along with a brief statement of the perceived scope of the work. The task force would then use the better part of its first year studying the subject area in general to determine the nature of the research program that the task force would propose. Growing out of this effort would be the identification of one or more specific research topics. The task force chairman would then propose a research topic to the Executive Committee. This was an opportunity to assure that the task force was on course and that it had properly interpreted the guidance it had received from the Board of Advisors. This basic approach still prevails and is well understood by members of the Executive Committee and the Board.

Figure 7 illustrates the interaction of the several participants in the CII research process.

By late 1988, CII had formed a total of 27 task forces. Several representatives of member companies indicated that they were having difficulty understanding and appreciating the full scope of work that CII was performing. It was proposed, therefore, at the Board meeting in November 1988 that the CII research program be classified into six basic thrust areas, and the acronym TOPICS was used to define these thrust areas:

T - Technology,

O - Organization,

P - People,

I - Information,

C - Controls, and

S - Sigma (Sigma being the Greek letter word meaning the sum of all else).

Using the TOPICS acronym, members of the Executive Committee were assigned to serve as oversight representatives for each of the six thrust areas. This, in a sense, borrowed from the practice in the early stages of CII's research program of having a liaison representative to work with each of the task forces. The basic purpose of this Executive Committee oversight was to provide a degree of continuity and understanding of the work being done or having been completed in each of the thrust areas.

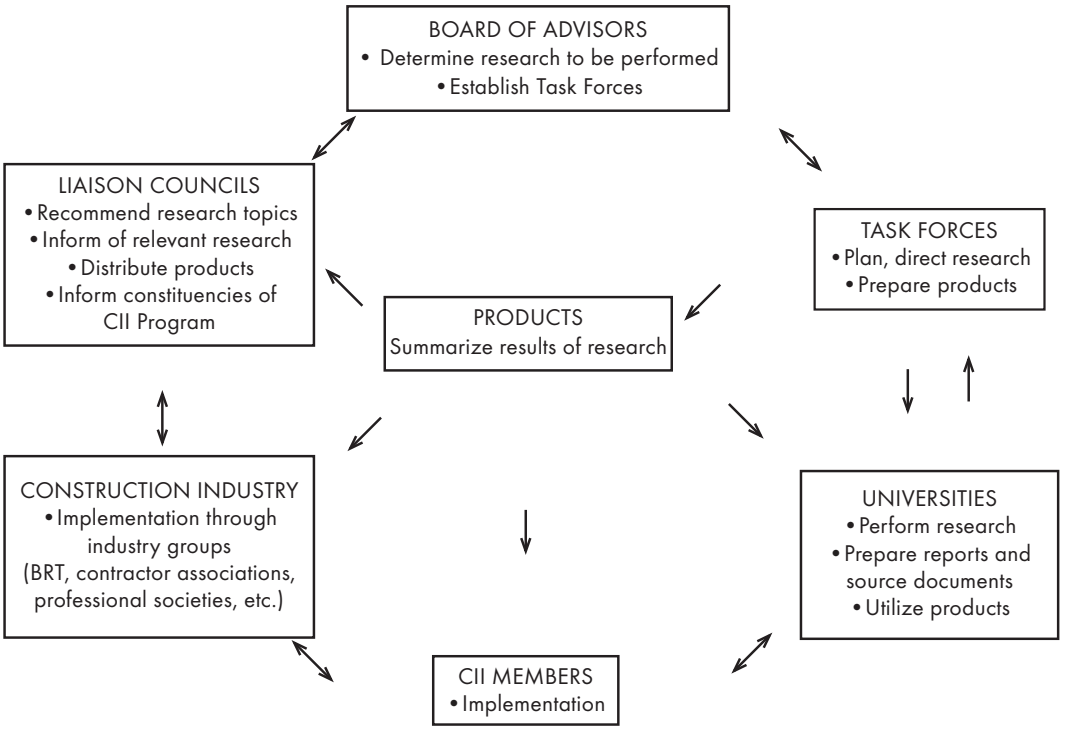
A continuing concern, however, was the process for selecting new research topics and establishing new task forces in a way that assured that the interests and needs of the

membership were appropriately reflected. Having decided upon the classification of the research program into the TOPICS thrust areas, the Board adopted a new format in 1989. The April Board meeting was to be an opportunity to assess the status of CII's research program, to review both the work which had been done and the work which was under way in each of the thrust areas. Workshops would be held at the meeting for each of the six TOPICS thrust areas, with the Executive Committee representative chairing the workshops.

The workshops allowed the membership to review the status of ongoing research in a thrust area and suggest topics for new research. A list of possible topics for consideration was provided by the CII staff to each workshop and included all suggestions from various sources. The same workshop approach would also be used at the Fall Board meeting. Each workshop recommended one to three new task forces to the Board. The Board prioritized these with the ultimate decision on the number of new task forces being dependent upon resources available to support new task forces. This approach utilized the Spring Board meeting to assess the status of the research program, and the Fall Board meeting determined the direction of future research.

At each Board meeting, members of the Board of Advisors were permitted to partici-

Figure 7 CII Research Process



pate in whatever workshop they preferred. As this process evolved, it became clear that it would be desirable if, once a person opted for a particular thrust area workshop, that person would continue to participate in workshops for that thrust area over time. This led to continuity and understanding of the research program in each thrust area and better judgments with respect to formation of new task forces.

While this approach worked well in 1989, a decision was made to depart from it to some degree in the Fall Board meeting of 1990. Workshops were still conducted for each of the six thrust areas, but workshop participants were requested to address the same questions: What research should CII perform to reduce total project costs by 20 percent, total project durations by 20 percent, and improve project safety by 25 percent? These were goals which the Executive Committee and the Board had earlier considered to be appropriate for CII to target for the Year 2000. Unfortunately, this approach did not work well. The recommendations which were ultimately presented to the Board were considered too vague for the Board to act upon. This coincided with a projected reduced level of funds available to support research for 1991. As a result, no new task forces were created during the Board meeting conducted in November 1990. The Board, however, did authorize the Executive Committee to consider a small number of projects which might have merit for early funding.

In early 1991, Tucker and the staff reviewed the difficulties that had occurred during the November meeting to determine what mechanism could be utilized to improve the formation of new task forces for the 1991 Fall meeting and in the future. The approach of having an Executive Committee delegate designated to exercise oversight for each of the thrust areas was considered to be sound. The decision was made to revert to the former approach for the Spring and Fall Board meetings; that is, of having the Spring Board meeting serve as an assessment of the overall program, and the Fall Board meeting reserved as a time to create new task forces. The workshop approach was thus reaffirmed on the basis that the workshops would address specific topics within their thrust areas.

One basic change, however, was adopted. A short list of candidate projects would be presented to the workshops from which they could make their choices. The short list would be developed from input by the staff, task forces, prior years' workshops, and the CII liaison councils. In short, the staff would consider virtually any source of input for possible new research topics. The Director, with the support of the Executive Committee, would develop an appropriate short list for each thrust area. With this short list, the Director would then conduct meetings with each of the Executive Committee members who had oversight responsibilities in order to prepare them for the Spring and Fall Board meetings. This process was pursued in 1991 and was extremely effective. The Board meeting conducted in November 1991 was efficient and resulted in

decisions to create the following new task forces: Project Change Management, Drug Free Workplace, Workers Compensation Insurance, Technology Strategy, Piping Function, Environmental Remediation Technology, International Standards, and ADA Impacts.

Chuck McGinnis had joined CII as Associate Director in August 1987 to further develop and refine the research program. He had informed Tucker in 1990 that he would retire effective on his sixty-fifth birthday, which would be January 31, 1993. Tucker, therefore, sought a replacement for McGinnis who would be brought in before the retirement date so that the new Associate Director could acclimate to the tasks at hand and be familiar with some of the principal participants in the research and administrative areas. In November 1992, Jon C. Vanden Bosch, formerly head of Capital Projects for the City of Houston, was hired to replace McGinnis. Vanden Bosch attended the 1992 Fall Board meeting held in Wesley Chapel, Florida, and was introduced to the Board.

Following the procedures from the November 1991 meeting, the Board created six new task forces at its November 1992 meeting: Design for Safety, Partnering II, Project Organization II, 3D CAD Link, Project Team Communications, and Predictive Tools.

One of the governing concepts in the creation of CII task forces is that they are ad hoc in nature, each with a relatively short life. Three years is a nominal life cycle for a task force, with the first year being involved primarily in the definition of the research program that it will perform, the second year involving the accomplishment of the research itself, and the third year spent preparing publications and reports. At the end of the nominal life cycle, each task force would sunset.

The concept of sunsetting a task force—that is, dismissing the members from duty once their work had been completed—was distressing to some. Members of the task forces had developed such effective working relationships that they desired to continue working together because they felt they could bring value to CII and the industry. Because a task force cannot in its nominal three-year life cycle address all issues that might be inherent in a given subject area, new task forces often are created that address subject areas already studied. The newer task forces, however, look at different topics within a subject area. In some cases, task forces exceed their nominal life cycle; however, the basic concept of sunsetting is the norm.

When a research project has been completed at a university, the results of the study are reported first to the task force for review, and then to CII. These reports are called source documents. CII does not dictate the results of research performed at different universities. That would be inconsistent with the concept of academic freedom. Each research report is required to meet the standards of the university itself with respect to its quality and content. It was recognized, therefore, that each task

force would be required to prepare a summary level publication describing the results of the research. A typical CII publication might be in the range of 20-30 pages and would serve as an executive summary of the source document. Task forces in some cases, however, incorporate the results of two or more research projects into a single publication. In other instances, publications reflect inputs from other sources as well as the specific university research projects. Both the source documents and the publications have become strong tools in the CII implementation program.

The CII research program has been highly effective, primarily because of the participation of knowledgeable and experienced people made available by the members of CII to participate on the task forces (listed in Appendix C) which have proposed the research and then managed it. The work performed by the academics in various universities throughout the country has made a major contribution to the success of this research program. The results of the implementation of this research will be summarized in the next chapter.

Chapter 6

IMPLEMENTATION

Although CII is a research organization, performing research is of little value if the results of the research are not put to work and assimilated into the way companies plan and execute projects. If the source documents and publications are not distributed throughout CII member companies and the industry, then little will come from the efforts of CII. From the beginning, it was understood that CII had to take a leadership role in the area of implementation. To that end, the Board created the Implementation Committee in 1984.

The first concern of the Implementation Committee was the way in which the results of CII research would be published and who would exercise quality control over CII publications. The first significant position reached by this committee was that CII would not exercise control over the quality or content of the source documents, which are the research reports from universities to CII. While the task forces had a continuing responsibility to assure that the universities involved met the terms of their contracts, the universities themselves were responsible for the quality of their efforts. To emphasize this point, source documents were initially printed without any CII cover or CII logo. Ultimately, this was a problem for the users of the source documents. In 1987, CII began printing the source documents with its logo on the cover so the reports would be readily identifiable by the membership and by industry in general.

The Implementation Committee did exercise a quality control review of CII publications, the summary-level documents produced by the task forces. The first level of responsibility for quality was the task force, but the Implementation Committee would perform a final review. The committee considered the task forces to be specialists in the fields they were addressing. In contrast, the Implementation Committee viewed itself as a collection of generalists—a microcosm of the membership and of the industry at large. The committee reviewed draft CII publications to ascertain if the final products would add value to the industry. While there have been few instances where the Implementation Committee has rejected a draft publication, there have been numerous instances where the committee returned a draft publication for significant restructuring and revision.

As the subject of implementation received increasing attention by the membership, the Executive Committee, and the staff, it was clear that implementation meant change—change in the way companies plan and execute

projects and change in the way individuals within companies would perform their work.

Significant barriers to change, however, did exist. In many cases, champions of the status quo existed: competent and experienced people who had a vested interest in the way things were being done at the present time and who were reluctant to consider the possibility that there might be some potential for improvement. In some cases, large and successful companies entered into their participation in CII from the point of view that they would share their competence with the rest of the industry. In some cases, these companies believed that they really did not have much to learn, and there was not much potential for them to improve the way they handled their projects. It was recognized that complacency, perhaps even arrogance, could be a major impediment to implementation. Other impediments involved a shortage of time, a shortage of people, or a shortage of money. In summary, as new CII material was produced, there was a broad reluctance to adopt new ideas and put them into practice.

At the same time, the membership realized that implementation must take place within the companies themselves—CII could not make it happen. It was also recognized, however, that there was a potential for the staff to provide support and assistance to its membership and to the industry at large. Accordingly in late 1987, Robert F. Jortberg, who had served as a representative on the Board of Advisors as president of Lummus Construction Company, was invited to join the CII staff as an Associate Director. Jortberg also had been chairman of the Constructability Task Force, one of the initial seven created in 1983. Working with the Implementation Committee, he prepared a concept for an overall CII implementation program and also prepared a paper entitled, "Statement of a Concept for Implementation Program within CII Member Companies." The purpose of these papers was to stimulate interest and discussion within the Implementation Committee and the membership.

During the November 1987 Board meeting, an Implementation Workshop was conducted to review the basic approach to CII implementation and to develop some general policies for the future activities of the staff. During the Spring Board meeting in 1988, another Implementation Workshop reviewed the broad range of subjects associated with implementation at the individual company level.

During 1987 under the leadership of Thomas R. Haggard, the CII Technical Writer/Editor, a Speakers Bureau was established utilizing volunteers from member companies who had served on task forces. These members offered to speak on the subject matter which their task forces had addressed. The Speakers Bureau supported the Local User Councils of The Business Roundtable by presenting workshops, seminars, and individual presentations. The level of effort of the Speakers Bureau grew significantly as the task forces produced new products to the extent that in 1988 approximately 100 separate

Speakers Bureau programs were presented. The coordination and logistics of the activities generated by the bureau were transferred in 1988 to Sam A. Shinn, who had recently been hired as a member of the CII staff. The Speakers Bureau now supports activities of the Local User Councils of The Business Roundtable, the Project Management Institute (PMI), the American Association of Cost Engineers (AACE), and other organizations of similar nature.

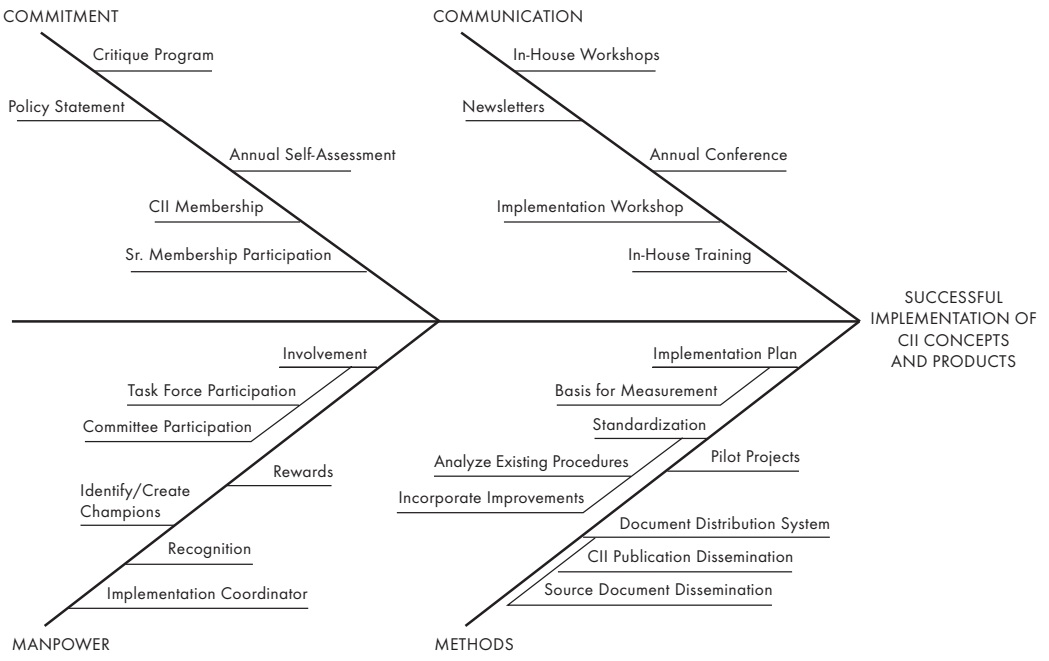
In 1988, the Implementation Committee became pro-active. It expanded its role beyond the scope of reviewing draft publications and took a leadership role in encouraging member companies to develop aggressive implementation programs. Under the leadership of Stephen H. Grote of Brown & Root, the committee developed a number of implementation concepts, including the need for companies to publish policy statements regarding their intention to initiate implementation programs. These policy statements would be distributed within the member companies. It also proposed the development of a self-assessment survey and a CII implementation audit program to be performed by the CII staff at the request of individual companies.

During 1988, Jortberg initiated a program of visiting member companies. Over the next year, he visited approximately 50 member companies in order to review the status of their implementation. This provided insights into the level of implementation activity and the nature of the problems associated with implementation programs. As a result, he prepared a special CII publication entitled, "Guidelines for an Implementation Program," which summarized the nature of implementation and the activities which would be appropriate to stimulate an implementation effort.

In October 1989, CII conducted an Implementation Workshop (separate from those conducted at Board meetings). In a sense, it was similar to the CPI Conference. The workshop was conducted to bring together people from member companies who had interests in and responsibilities for company implementation programs. The workshop was well received by approximately 90 participants representing 70 CII member companies. Representatives from several companies spoke of their actual experiences and difficulties with implementation programs. Charles R. McGinnis of the Chevron Corporation led the group through a workshop exercise in the development of a "fish-bone" diagram which highlighted the essential elements of an implementation program. This original "fish-bone" diagram, shown in Figure 8, is an illustration of the thinking at that time of the nature of the implementation effort.

At an Implementation Committee meeting conducted immediately after the workshop, a proposal was made to develop a formal Implementation Plan for 1990. The plan would be presented to the Executive Committee and to the Board of Advisors in November. As a part of the Implementation Plan, it was proposed to create a new operating entity within CII: implementation action teams.

Figure 8 Implementation Workshop, October 1989



Building on the same participative model of the CII task forces, the action teams were composed of volunteers from CII member companies, but were smaller in size (only six to ten people) and without the services of an academic, since no research effort would be involved. The original action teams were: Plants/Divisions, which would address implementation in the decentralized owner organization; Pilot Projects, which would focus on using a project as an implementation tool; Small (Special) Projects, which would examine how CII products could be implemented in the small project arena; Marketing, which was to promote CII product use among member companies; and the Local User Councils Action Team, which would help to promote the ties between The Business Roundtable LUCs and CII. The original action teams produced the first major implementation products of CII.

The action teams were a key part of the Implementation Plan that was developed for 1990. The plan defined the role of the Implementation Committee to include supporting member companies; developing tools and techniques for implementation, such as publications, speaker bureaus, videos, and workshops; and supporting industry-wide implementation through the Speakers Bureau and Local User Councils. The plan called for increasing participation by representatives of CII member companies in the CII implementa-

tion process. The principal mechanism for increasing participation was the creation of the new implementation action teams. The original action teams were to focus on specific implementation problems with a user focus.

The plan also called for eight new publications during 1990: five reprints, four quarterly editions of a newsletter, C*onstruction Industry Institute News*, and the annual report. It was also expected that CII would produce four videotapes and a series of slide presentations on selected task force material. Staff effort was intended to include company visits, and critiques when requested; support for pilot projects; editorial support for task forces; publication management; video production; operating the Speakers Bureau; supporting the Annual Conference; supporting the CPI Conference; managing the annual Implementation Workshop; and supporting the liaison councils.

The annual CPI Conference was also included in the plan as a significant element of the overall implementation effort. With its focus on operational level personnel, it communicates CII concepts to people with hands-on responsibilities for projects. It also disseminates the CII message to people outside of the CII member companies.

Jortberg recognized the potential of the implementation area and recommended that a full-time Associate Director position be established. Because of time limitations and other logistical reasons, Jortberg would devote his attention to the growing CII liaison activities while an additional staff member would be recruited for the full-time implementation position.

In August 1990, James A. Broaddus replaced Jortberg as Associate Director for Implementation. Broaddus had represented the Naval Facilities Engineering Command, a CII member, on the Contracting Phase II Task Force, and thus was familiar with CII. He immediately began work on the Implementation Plan for 1991. The plan was presented to the Board of Advisors in November and approved. Broaddus worked closely with the 1990 Chairman of the Implementation Committee, Richard Bankhead of Weyerhaeuser Paper Company. They developed the 1991 Implementation Plan to include four basic thrust areas: planning, communication, education, and measurement. They categorized each of the ongoing implementation activities into these thrust areas.

Thus, by January 1991, CII had brought implementation to the forefront of its activities: the 1991 plan was in place, the Associate Director for Implementation was on board, and action teams had begun the work that the Board deemed vital to the future of CII.

Other implementation activities occurred as well. The Implementation Committee was restructured during 1991 to include a Strategy Subcommittee, a Products Review Board, and an Education Module Review Board. These changes reflected the need for comprehensive thinking about the major issues involved in the implementation area and the continuing need

for quality control of CII products.

One of the major implementation efforts resulted in an education thrust that is described in the next chapter. The education effort grew to the level of requiring its own leadership, and Broaddus decided to devote his full attention to that effort. Broaddus' reassignment within the CII staff to provide leadership for the education program left CII's implementation staff position open. In mid-1993, W. David Nelson joined the CII staff as Associate Director for Implementation. Nelson began his association with CII in 1985 as a Board representative of Standard Oil of Ohio. He was a member of the CII Constructability Task Force and thus knew of the inner workings of task forces and implementation efforts.

The implementation challenge will always be present. As CII develops new material through its task forces, it will be important to integrate this material into industry. CII is available to support and assist. Ultimately, however, implementation remains a company requirement and a company challenge.

Chapter 7

EDUCATION

The implementation efforts that began in earnest in 1987 developed rapidly and with the full support of the Board. Now a new thrust—education—became a focal point for CII. By 1991, it was clear to Tucker, the Executive Committee, and the Board of Advisors that education must be a meaningful, if not the key, element of any implementation effort. It was decided that a formal approach should be made to the development of both educational material and a delivery system for that material.

It was planned to repackage CII products into education modules that would be relatively easy to use. The basic concept was that CII would prepare educational modules that would be used as material for educational programs and workshops by universities, member companies, Local User Councils, and other groups. It was recognized that some of the CII publications were structured in a way that made it difficult to use them in educational programs. In addition, some subject matter was covered by two or more publications. Accordingly, a Project Management Education Module Action Team was created in August 1990, under the chairmanship of Gary J. Wilson of Texaco, to develop a concept and basic format for CII educational modules. This action team created a standard that is now being used for the development of further modules. Their first module, "Optimizing Project Schedules," was based on CII Publication 6-7, Concepts and Methods of Schedule Compression. This action team later became the Education Module Review Board, which was assigned to pass judgment on the issuance of new education modules. This review step added time to the process, but improved the quality of the modules and the overall education program.

The action team suggested, and the Board agreed, that additional modules needed to be developed to convert CII research products into material for the education program. Plans were also developed for one-week university short courses, which would be offered first on a pilot basis through the Continuing Engineering Studies group at UT-Austin. Each of the courses would cover selected CII products. Two initial courses were conceived. The first course would address the subjects of organizing for project success, project objectives setting, managing uncertainty, design effectiveness (including the objectives matrix method for evaluating design effectiveness and inputs to the design process), scope definition, and constructability (including preassembly and modularization). The second week's program would address safety, productivity measure-

ment, optimizing project schedules, work packaging for project control, construction planning for start-up, materials management, and project quality management systems.

New action teams were created for each of these subject areas to develop the course material and, ultimately, to develop the final educational modules consistent with the format developed by the Educational Module Action Team. A steering committee, created under the leadership of Broaddus, later became the Short Course Action Team, which coordinated the development of these first courses. The educational action teams are listed in Appendix D.

A three-tiered approach was conceived for education that involved: (1) formal university short courses of approximately one week each; (2) company programs; and (3) regional workshops conducted by CII, Local User Councils, and others. Some within CII estimated that between 5,000 to 10,000 individuals per year would seek this form of education.

The lessons learned in the initial pilot courses resulted in significant improvements, and the course material was refined with the intent to export these modules to other universities as well as make them available for use within companies. By late 1991, it was clear that a special strategic planning effort would be required to insure a successful program with the short courses. DuPont offered the services of Robert H. Miller on an executive loan basis for a one-year period to pursue this effort. Miller brought considerable CII background and highly regarded leadership ability to the task, having been involved with CICE and the very foundation of CII. He had served as CII Chairman in 1986 and chaired the Strategic Planning Committee for several years as well.

Miller and Broaddus combined their efforts starting in November 1991. The education program began to make headway under their guidance. The first deployed courses based upon CII modules were offered at Arizona State University and Clemson in late 1992. Both schools later offered both courses several times per year, and a third course was piloted at UT-Austin in July 1993.

CII continues to believe that the education program has the potential for a major meaningful impact on the industry. It is interesting to relate this current approach to the earlier comments of Professor Oglesby of Stanford (presented in Chapter 3) with respect to the need for in-service education. He recognized the need in the 1950s. The need still exists, and CII is now producing products which will be useful in satisfying this need. Many members believe that the education effort will become one of CII's most significant contributions.

Chapter 8

LIAISON

The research, implementation, and education activities of CII are intended to benefit the entire U.S. construction industry, not just the CII membership. The focus on implementation within the CII membership is a priority since the Institute cannot encourage the industry at large to adopt the results of its research if its own members are not implementing them in an aggressive way. CII has recognized, however, that other organizations share a concern for the effectiveness of the construction industry, and it is important to maintain linkage with these organizations.

The Strategic Planning Committee noted that many contractor associations, professional societies, and research centers are, like CII, working to improve the productivity, cost effectiveness, and overall quality of the construction industry. The total available research resources, however, are small compared to the total need. Therefore, a liaison function was considered to be an important aspect of CII's overall operations in order to minimize duplication of effort and to build upon one another's activities.

Several liaison councils have been established to maintain this important linkage. These councils provide a mechanism that encourages free and open communication between CII and organizations concerned with the CII research. The councils also obtain information from their member organizations regarding their research. In addition, the councils are viewed as an effective mechanism for disseminating the results of CII research to a large number of organizations, companies, and individuals.

In the original CII Strategic Plan developed in 1985, three councils were created: The Business Roundtable Council, the Academic Council, and the Contractors Association Council. In addition, an Industry Liaison Committee was established.

CII recognized that the Construction Committee of The Business Roundtable would continue to pursue the implementation of the results of the CICE Project through its network of Local User Councils (LUCs). It was considered appropriate to maintain a strong relationship with the Construction Committee because CII viewed the LUC network as a particularly effective way of disseminating research results. Many CII member companies participate in meetings of the LUCs. Thus, The Business Roundtable Council provides an opportunity to (1) disseminate the results of CII work to the working levels of Roundtable member companies and (2) to identify areas of

research considered important by the owner community.

CII planned to utilize a large number of universities and colleges in the performance of its research program, and the Academic Council was established as a support mechanism. It was desirable for CII to know the capabilities of the several universities and the interest which they might have in performing CII research. It was also considered important to have strong linkage to the academic community so that the results of CII research could be incorporated into the curricula of these schools. An underlying objective of CII is to upgrade the quality of construction education in the United States. This can be achieved by the participation of academics on CII task forces, by the accomplishment of CII research, and by the incorporation of the results of CII research into college curricula.

The Contractors Association Council was intended as a linkage with the major contractor associations. During the early meetings, it was decided to limit the linkage to six large contractor associations including Associated General Contractors of America (AGC), National Constructors Associations (NCA), Associated Builders and Contractors (ABC), National Electrical Contractors Association (NECA), Mechanical Contractors Association of America (MCAA), and the Sheet Metal and Air Conditioning Contractors National Association (SMACNA). Later, the National Insulation Contractors Association (NICA) was added.

The Industry Liaison Committee was created as an umbrella committee to maintain linkage with elements of the industry not represented by the other councils. This committee recommended the creation of additional councils, each with a more narrow focus to maintain linkage with professional societies, construction suppliers associations, and other research centers. These new councils were formed in 1988. A new Industry Liaison Committee was described in the revised CII Strategic Plan in 1991 with the intention that the chairmen of these councils would compose the Industry Liaison Committee.

In 1990, the International Council was formed to communicate with organizations in different parts of the world that have expressed an interest in emulating CII. It was felt that a council that would focus on international activities would benefit the operations of CII, and might also benefit international organizations in communicating the results of CII research.

In 1993, there are a total of seven councils: the Academic Council, The Business Roundtable Council, the Construction Suppliers Council, the Contractor Associations Council, the International Council, the Professional Societies Council, and the Research Centers Council. The organizations represented on the councils are listed in Appendix E.

Chapter 9

CII ANNUAL CONFERENCES

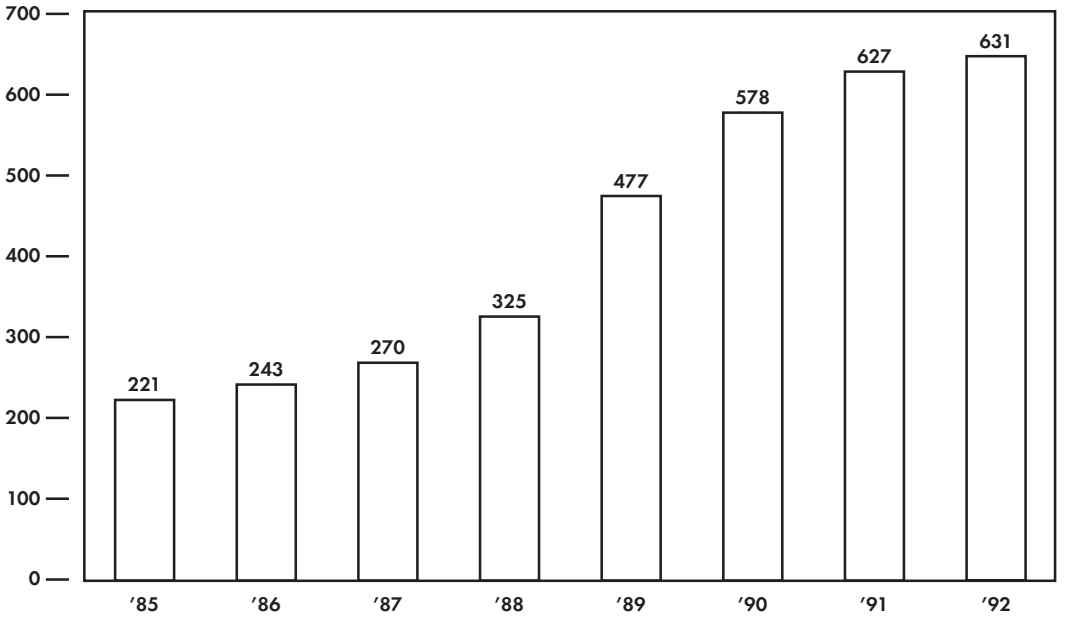
In late 1984, the Board of Advisors began planning for a first-time event: the CII Annual Conference. The conference would provide an opportunity for all of the people participating on CII committees, councils, and task forces, many of whom were not members of the Board, to meet and exchange information with respect to their activities and gain a deeper understanding of the total scope of the CII effort.

The first Annual Conference was conducted August 6-8, 1985, at Keystone, Colorado. The program presented status reports by eleven task forces, the Contractor Associations Council, and the Implementation Committee. There were no task force products at that time. Donald Hodel, the U.S. Secretary of the Interior, spoke at the conference on August 7th.

In succeeding years, the conference was held in Asheville, North Carolina; Snowmass, Colorado; Beaver Creek, Colorado; Coronado, California; Nashville, Tennessee; Monterey, California; and in 1992, at Orlando, Florida. Figure 9 indicates the increasing level of participation in the conferences over time. Its attendance is now controlled at about the 600-650 level to maintain an informal atmosphere. To accomodate the overflow demand, the Construction Productivity Improvement Conference has been restructured and renamed (it is now the Construction Project Improvement Conference) to present the identical program one month later.

Several Annual Conferences were the occasion of notable events. In 1986 at Asheville, North Carolina, the first six CII summary publications of research were presented. At Snowmass, Colorado, in 1987, CII Chairman Gary Jones challenged each member organization to implement at least one concept developed by CII research during the coming year. In 1988 at Beaver Creek, Colorado, "breakout sessions" were held for the first time to allow more details to be provided to conference participants. In 1989 in Coronado, California, a presentation on Total Quality Management was presented by Florida Power & Light executive Bud Hunter. In 1990 at Nashville, Tennessee, former U.S. Secretary of State George Shultz was the featured speaker, and talked of international affairs right at the time that activities in the Middle East were developing into what would evenually become Desert Storm. At Monterey, California, in 1991, former President Ronald Reagan addressed the attendees and their families and presented the first Ronald Reagan Award for Individual Initiative to Dr. Richard L. Tucker.

Figure 9 Attendance Trends: CII Annual Conference



As task forces completed their work and published the results of their research, it became clear that the Annual Conference could be a major implementation tool. This annual event became an effective vehicle to introduce new CII products and for member organizations to report on their experience in the implementation of results of previous research. The format of the Annual Conference evolved as CII experimented to find the most effective mechanism for task forces to speak of their products and member companies to discuss their projects. There was also a concern for how participants in the conference could gain the maximum benefit from their attendance.

The format which best satisfies these needs provides for approximately 12 summary presentations of 20 minutes each, made to three plenary sessions of the conference, four in each session. These may be task force presentations or company presentations. Following the conference plenary sessions, the participants attend one-hour breakouts where the material presented earlier is explored in-depth. The presenter presides and has representatives of the task force or the company involved with him to respond to questions. Conference attendees are free to participate in any of these breakouts. In addition, the CII Forum is now included in the conference program.

The Annual Conferences have become a significant event for CII participants. This success is largely due to a commitment to seek a high degree of excellence in every aspect, from the physical facilities of the location to the quality of the program.

The Annual Conference Chairman is selected each year by the Nominating Committee and proposed to the Board of Advisors for their concurrence in the November Board meeting. The Conference Chairman is an ex-officio member of the Executive Committee and meets periodically with that Committee to keep it informed on the status of planning for the conference.

Early each year, a letter is distributed to the membership and to the chairmen of the various task forces and implementation action teams requesting that they consider nominating a candidate subject for the upcoming Annual Conference. In March or April, a tryout session is held where presentations which have been nominated are reviewed by an ad hoc group under the leadership of the conference chairman. The presentations are not expected to be in final form at that time. The basic content of the presentation, however, is reviewed. Normally, several more candidate topics are proposed than can be accommodated in the program. Topics are selected which provide a balance between task force and action team products and member company success stories. The content of previous years' programs is reviewed from year to year to assure diversity in the material that is presented.

Upon completion of this evaluation and the selection of the material for the program, the task forces, action teams, and member companies are advised to prepare for a "dry run," usually conducted in June each year. The dry run is expected to be a clean version of the final presentation. Slides for most presentations are prepared by the CII staff to assure a high degree of uniformity, consistency, and quality. Where it may become necessary, separate members of the ad hoc committee or the CII staff, under the direction of the conference chairman, work with individual presenters in solving problem areas. The dry run is expected to cover not only the 20-minute plenary session presentation, but also the content of the breakout. Presenters are also requested to prepare handout booklets for their breakouts. These publications are given to conference participants in advance so that they will be aware of the general content of each presentation and thus can exercise an informed judgment when choosing which breakouts to attend.

In order to make best use of the time and travel expense committed to the conference, most committees, councils, task forces, and action teams conduct meetings immediately before or after the conference. Recreational activities are also scheduled, including golf, tennis, and various events for spouses and children.

In 1992, the long-running CPI Conference for the first time consisted of most of the CII Annual Conference presentations and the accompanying breakout sessions. The reformatting was an overwhelming success as attendance tripled. In addition, industry participants outside of the CII membership could hear the success stories presented at the CII Annual Conference. The CPI conference also offered the presenters a different level of the industry. Whereas the CII Annual Conference

draws high level management, CPI traditionally has drawn participants who are more likely to be found in such positions as project managers, project engineers, materials management personnel, and others. The CPI Committee for 1993 planned a repeat of the 1993 Annual Conference in Austin in September.

Considerable attention is given to the selection of a guest speaker for the Annual Conference and also to the topic and participants in the CII Forum. The Strategic Planning Committee is responsible for planning and arranging the Forum. Topics have included international construction, dispute prevention and resolution, the construction work force, and the ISO 9000 standards for construction in the European Community. In addition to those noted previously, other notable guest speakers have included Dr. Margaret Maxey of UT-Austin, Arthur J. Fox, editor of *ENR*, and Bill Sims of Walt Disney Imagineering.

Chapter 10

AWARDS AND RECOGNITION

The leadership of CII held extensive discus-sions during 1984 and 1985 concerning the most appropriate way to recognize individuals who had made a significant contribution to the betterment of the construction industry. While several approaches to the establishment of CII awards or other forms of recognition were considered, the Executive Committee ultimately established the Carroll H. Dunn Award of Excellence in 1985. The purpose of the award is to recognize an individual who has had singular and notable responsibility for significant advancements in improving the cost effectiveness of the construction industry. The award is given only when a worthy recipient is apparent. Selection of the recipient is made by the Executive Committee with the criteria for selection including the following:

- Significant contributions to the cost effectiveness of the construction industry
- Demonstration of the highest degree of personal dedication to the goals of cost effectiveness
- A level of knowledge and breadth of experience that distinguish the recipient as an eminent authority
- A leadership position in the construction industry from which others can be influenced by example and direction
- A record of accomplishment that brings added distinction to the recipient, the organizations with which he or she has been associated, and to the industry at large.

In deciding to establish this award, the Executive Committee determined unanimously that the award should be named for Carroll H. Dunn and that General Dunn should be its first recipient. These actions were taken in total secrecy so that when the award was announced at the banquet during the 1985 Annual Conference, the award was a total surprise to General Dunn as well as to members of the Board of Advisors.

It was clear that Carroll Dunn met all of the criteria for the award. Not only had he completed an exceptional career in the U.S. Army Corps of Engineers, retiring in 1973 as a Lieutenant General, he had served as Vice President, Construction for Consolidated Edison Company, and ultimately was promoted to Senior Vice President, Construction, Engineering and Environmental Affairs. In May 1980, Carroll Dunn began as a full-time Project Director for The Business Roundtable

Construction Industry Cost Effectiveness (CICE) Project. The project's success was, to a major degree, due to the leadership that Carroll Dunn brought to it. As has been described earlier in this history, Carroll Dunn also contributed significantly to the formation and development of the Construction Industry Institute. While retired, he continues to participate in meetings of the CII Strategic Planning Committee and serves as a valuable source of counsel to the Director and the Executive Committee.

The second recipient of the Carroll H. Dunn Award was Charles Daniel Brown, Vice President for Engineering of DuPont. In addition to Charlie Brown's contribution to the improvement of the construction industry incident to his long-time service in DuPont, he also served as the leader of the original task force created in 1977 to initiate The Business Roundtable Construction Industry Cost Effectiveness Project. Brown provided direction and leadership to the Construction Committee as well as to the CICE project throughout the five years of that study. As a result of his contributions to the industry and to the CICE Project, Brown was also recognized by *Engineering News Record* as its 1983 Man of the Year.

Ted C. Kennedy was the third recipient of the Dunn Award. Ted Kennedy, one of the founders and owners of BE&K Inc. in Birmingham, Alabama, had served as National President of the Associated Builders and Contractors in 1980 and has contributed to a significant degree in the development of craft level training programs for the merit shop sector of the U.S. construction industry. He has served on The Business Roundtable Contractors Advisory Council and, in 1988, was awarded the Outstanding Engineer of the Year Award by the Professional Engineers in Construction for the State of Alabama and the Walter A. Nitrate Constructor Award by the American Institute of Constructors. Since CII's early days, Ted has been an active participant. He has served on the Executive and Implementation Committees and served as the CII Chairman during 1989.

The fourth recipient of the award was Robert H. Miller who has had leading roles both in DuPont and in The Business Roundtable Construction Committee's CICE Project. Miller was one of the prime movers in the creation of the Construction Industry Institute in October 1983. He was an original member of the Board of Advisors and served as Chairman of CII in 1986, a year in which his drive and determination led to the first published results of CII research. He has also chaired the Strategic Planning Committee and the CII Business Roundtable Council. Bob Miller has made a lasting contribution to CII and to the construction industry.

The fifth recipient of the Dunn Award was Louis Garbrecht, Jr., who was the prime mover in bringing together people from diverse interests and backgrounds for a preliminary meeting in February 1983 to consider the creation of some form of research organiza-

tion. Garbrecht's initiatives led to the formation of the Construction Industry Institute. He has served in several responsible positions with Texaco, retiring as the General Manager for Engineering. The CII Executive Committee's choice of Louis Garbrecht for the Carroll H. Dunn Award not only recognized his meaningful contribution, within Texaco, but also the role he played in the formation of the Construction Industry Institute.

The sixth recipient of the award was Clarkson H. Oglesby, the first academic to receive this recognition. Oglesby's contribution to construction education and research has been documented in Chapter 3. He was one of the first in the academic community who had a serious interest in and concern for construction education and research. In 1956, he took charge of Stanford University's efforts to establish an offering of the first graduate courses in construction in the United States. He coauthored classic textbooks on construction productivity, methods improvement for construction managers, and highway engineering. He was a member of the National Academy of Engineering and a recipient of the ASCE Peurifoy Award for Construction Research.

The seventh recipient of the award was James M. Braus, a principal author of the CII Strategic Plan and the update to that plan. Braus played a role in the CICE Project and was Shell Oil's representative to the original CII Board of Advisors. He chaired the 1987 Annual Conference in Snowmass, Colorado, and is recognized within CII as a diplomat who works behind the scenes to help CII accomplish its goals. It was during his chairmanship of the Snowmass conference that implementation surfaced as a major issue within CII. Through Braus's leadership and persuasiveness, the members agreed to begin a new level of effort in putting the CII research results to work on real-world projects.

Reviewing the contributions of these individuals, it is clear that the industry has benefited from their vision, leadership, energy, and drive. CII believes that there will continue to be men and women of the stature of these recipients who will contribute to the cost effectiveness and total quality of the construction industry. CII will continue to consider individuals for future recognition through the Carroll H. Dunn Award of Excellence.

In conjunction with the willingness of former President Ronald Reagan to address the 1991 CII Annual Conference, the Executive Committee considered that it would be appropriate to express its appreciation to President Reagan by creating an additional award. Again, dealing in total secrecy, the Committee voted to create the Ronald Reagan Individual Iniative Award and considered it appropriate to name Richard Tucker as the first recipient of this award. The citation, presented at the 1991 Annual Conference by President Reagan, recognized Tucker's initiative and innovative thinking in the formation of CII. The award also recognized Tucker's leadership and direction of CII during its formative years.

The association between CII and The

Business Roundtable has been a long and supportive relationship since the foundation of CII. The Roundtable's CICE Project had recommended that a research institute be formed so that industry participants could work together to improve the industry's cost effectiveness and total quality. The first task force formed by CII was the CICE Impact Task Force, established to investigate the awareness within the industry of the massive five-year study. Additionally, the Fall Board of Advisors meetings have been held in conjunction with the Roundtable's National Construction Conference, which is traditionally held each November. Since so many members belong to both organizations, the overlap provided by the two meetings enables participants to attend both important meetings. In November 1991, The Business Roundtable commended CII at its national meeting in Hilton Head, South Carolina. Richard Tucker received a plaque on behalf of CII from The Business Roundtable. The plaque reads: "The Business Roundtable commends CII for its outstanding work in making the construction industry more cost effective." The plaque is displayed proudly at the CII office in Austin, Texas.

To recognize individual contributions, three graduate fellowships were established by CII on January 1, 1993, in the names of Carroll H. Dunn, Charles I. McGinnis, and Robert F. Jortberg. Plaques signifying the fellowships are on display in the CII office. Each plaque reads in a similar manner, as illustrated by the plaque for General Dunn: "The College of Engineering of The University of Texas at Austin hereby honors Carroll H. Dunn with the creation of the Carroll H. Dunn Endowed Graduate Fellowship in Engineering, established by CII. We express our grateful appreciation for your role in supporting and advancing engineering education at The University of Texas at Austin."

Chapter 11

THE CII IMPACT

Previous chapters on CII research, implementation, and education programs have addressed the CII mission: to improve total quality and cost effectiveness. CII has committed substantial resources to these programs, with approximately 2,500 volunteers having worked on the Board of Advisors, committees, councils, task forces, and action teams. The total value of volunteer and budgeted resources applied to CII activities approaches $200 million, including the funding of research at approximately 30 universities in the amount of $10 million. Perhaps at this juncture it is appropriate to ask if CII has made a difference. Has the application of these resources to these primary programs improved the quality and cost effectiveness of the industry? Is CII accomplishing its mission?

No formal measurement system is in place by which these questions can be answered. Efforts are under way, however, to develop a measurement approach. It is anticipated that more indicators will be developed to determine the results of the CII programs. This concern for measurement of effectiveness, however, has not been ignored. Efforts were initiated in 1987 to begin collecting information on case studies of successful implementation of CII research. Information is available at this time that defines levels of implementation activity in member companies and in industry in general. A brief review of this information perhaps will contribute to an understanding of the impact CII has had on the industry.

The perceived value of CII publications by the industry is one such indicator. CII has published a total of 162 publications, including 37 summary level publications, 33 special publications, and 92 source documents. In addition, a total of 66 videotapes are available to assist in understanding CII concepts. Since all member companies receive five free copies of each publication and one free copy of each source document, and since CII publications are not copyrighted, the sale of publications over and above standard CII distribution can be an indicator of how the industry perceives them. For 1992 only, a total of 2,031 orders were received for publications, covering 18,146 items. The sales dollars totaling $246,482 were divided as follows: members - $100,645; non-members - $122,391; academics - $10,651; and others - $12,795.

While CII is confident that each of its publications adds value to the industry, several have attracted a high level of interest. The brief discussion that follows considers only a few publications. It is not intended to suggest that those

which are not included are of lesser value to the industry. The publications which have received the greatest demand and highest level of interest include:

- Constructability Series
- Project Objective Setting
- Evaluation of Design Effectiveness
- Input Variables Impacting Design Effectiveness
- Cost/Schedule Control Series
- Materials Management
- Partnering
- Organizing for Project Success
- Quality Series
- Safety Series

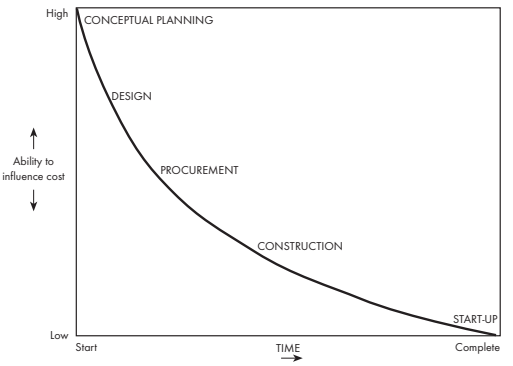
The constructability series, including the *Constructability Concepts File* (Special Publication 3-3), defines the importance of integrating construction knowledge and experience into all phases of a project. *Constructability: A Primer* (Publication 3-1) was the first publication to set forth the CII cost influence curve, which is shown in Figure 10.

The principle expressed by this curve has had a major influence on both owners and contractors. Project teams have addressed such issues as project objectives, scope definition, and project organization very early in the planning stages of their projects with significant benefits. In particular, CII Publication 12-1, *Project Objective Setting*, has provided guidance to project teams in the articulation of project objectives. This publication has also provided a mechanism for testing the understanding of objectives by all members of a project team. CII Special Publication 12-2, *Organizing for Project Success*, has provided guidance to project teams in understanding the dynamics of construction project organizations and team building.

Materials management has been addressed in a series of CII publications, the most notable being the *Project Materials Management Handbook*. This publication has generated an increased awareness among owners and contractors of the significance of materials management. Not only does this publication recognize that savings in the order of six percent of total project cost can be achieved through an effective materials management program, but it emphasizes to project teams the ultimate exposure to loss that will result from ineffective materials management.

CII Publication 8-1, *Evaluation of Design Effectiveness*, provides a tool for project teams to evaluate the effectiveness of the design function. This objectives matrix method has proved to be so effective that it has been utilized by several contractors and owners for

Figure 10 Cost Influence Curve



evaluation of construction projects as well as other applications. CII Publication 8-2, *Input Variables Impacting Design Effectiveness*, highlights the 10 most significant inputs that have an impact upon the design effectiveness of a project.

The CII series of publications on partnering, including two videotape productions, is recognized as an excellent resource concerning the relationships among owners and contractors. The term "partnering" was first used in the industry at the 1988 CII Annual Conference. Although partnering is normally considered part of long-term relationships, the U.S. Army Corps of Engineers and several state transportation departments have utilized partnering on single projects with impressive results.

Several products in the quality series have been instrumental in addressing such issues as the cost of quality and the implementation of total quality management (TQM) systems on projects. These publications have resulted in an increased awareness of how the desired quality can be achieved on projects through proactive planning and management.

The safety series has been instrumental in assisting companies in development of safety programs. Figure 11 illustrates the impact of the CII safety program reported by those companies represented on the Zero Accidents Task Force. The data represent experience for about 80 million work-hours per year. The results are compelling. Enhanced safety performance is possible. Additional data gathering is under way.

The value of CII publications is perhaps best illustrated by case studies in which member companies have implemented CII concepts with significant success. In order to communicate the results of these success stories, CII developed the format for its Annual Conference to include selected case studies by members. Since this approach was initiated, a total of 40 case studies has been presented. In fact, about 70 have been proposed for presentation, but since it is only possible to include five or six case studies in each Annual Conference, many could not be accepted. A total of 40 member companies has participated in presentation of these success stories, including 18 owners and 22 contractors. Since 1988, savings in excess of $400 million have been realized through the projects represented by these case studies alone. A savings of over $100 million is estimated from the projects described in the case studies to be presented at the 1993 Annual Conference.

Some of the case studies are particularly notable. For example, the Dow Chemical Company reported on three projects that achieved benefit-to-cost ratios of 30:1, 50:1, and 70:1 from the implementation of constructability. The Southern Division of the Naval Facilities Engineering Command employed an innovative constructability approach on a nuclear propulsion training facility. The contractors who bid this project reported that the plans and specifications were the cleanest package they had ever experienced. This project is now essentially complete with unusually low change-order experience.

Other indicators also illustrate the impact of CII's research on the industry as a whole. A comprehensive survey concerning the relative value of CII concepts was completed in 1989 by 428 companies with a total of 1,900 respondents. Table 1 illustrates the cost/benefit ratios that resulted from successful implementation of selected CII concepts.

Table 1 Successful Implementation

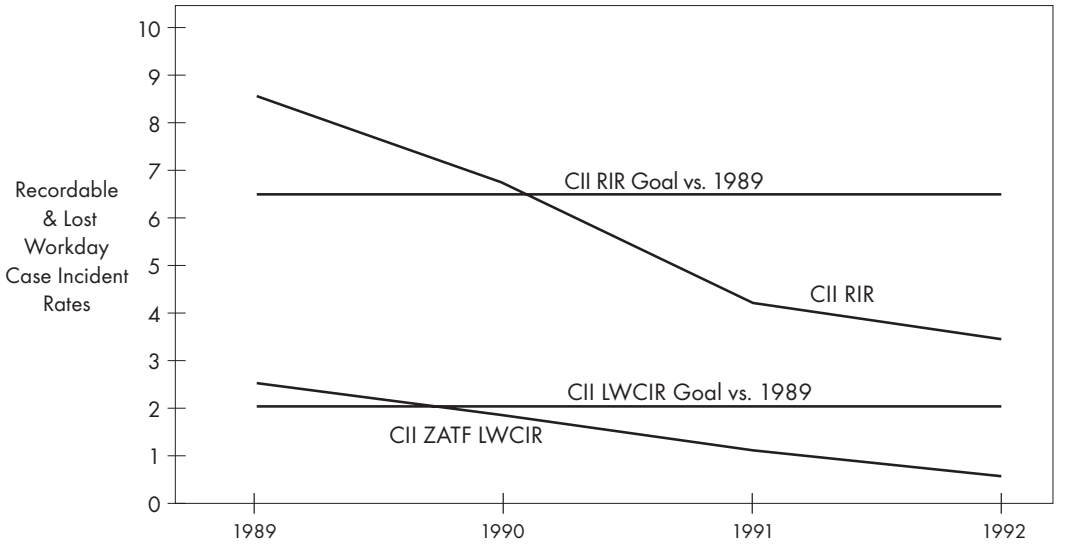
Management Category	Benefit:Cost Ratio
Strategic Project Organizing	20:1
Design Effectiveness	15:1
Human Resources Management	15:1
Project Controls	10:1
Management of Quality	10:1
Materials Management	10:1
Contracting Practices	10:1
Safety	10:1
Integrating Effort	15:1

In 1992, a survey was conducted concerning member company experience in applying the results of CII research compared to the total cost of their participation. The survey indicated an average 16:1 payback from participation in CII. This response is particularly interesting since it is recognized that many companies are in the initial stages of implementation programs and the fact that the CII educational program is still in its infancy.

This survey is also the basis for a conservative estimate of project savings of $250 million for 1991. As significant as this amount is, it pales in comparison to the CII goal of a 20 percent reduction in project costs by the Year 2000.

Another significant benefit accrues to those member company personnel who are active participants in the work of CII. Experience has shown that participation fosters significant professional growth and development.

Figure 11 CII Safety Data Benchmark
Zero Accidents Task Force Members (ZATF)



Interaction with peers and the opportunity to exchange information have proven to be of great value to those involved in CII. An atmosphere has evolved that encourages people to be innovative, indicating that it is acceptable to try a new idea—even though the idea may not work as well as might have been expected. A number of senior executives of member companies have indicated that the opportunity for their people to become involved in task forces, action teams, and other elements of CII is as equally important as the research products themselves.

Similarly, others have said that the opportunity to network is a valuable benefit achieved from CII membership. Networking involves companies as well as people. The CII member companies have come to understand each other better and to develop a basis of trust and understanding. This has contributed significantly to the reduction of adversarial relationships and to the formation of partnering arrangements in many cases. Networking has extended beyond the U.S. to a number of international communities. Many groups in other countries have visited CII and have expressed an interest in how CII works. Counterpart organizations have been created in Australia and in Europe with support and assistance from the CII staff.

While it is not specifically articulated in the CII mission, CII has a desire to upgrade construction education in the U.S. The involvement of academics has contributed to an increased understanding of how the construction industry operates in the real world. Faculty members and graduate students, through their work on task forces, have come to understand companies and their problems and how the curricula being presented in the colleges and universities can produce graduates who will be more effective in the construction industry. Similarly, many companies have utilized faculty as consultants when introducing new programs. Several universities have incorporated the results of CII research in their courses.

Because it is addressing the needs of the construction industry as a whole, CII has provided support to a number of other organizations, primarily through its Speakers Bureau. CII has provided many programs for Local User Councils of The Business Roundtable, including workshops, seminars, and luncheon and dinner presentations. In addition, CII has participated in programs of the Project Management Institute and the American Association of Cost Engineers, and has provided assistance and support to the Engineering and Construction Contracting Division of the American Institute of Chemical Engineers. CII has communicated the results of its research to these and other organizations in such a way that the industry as a whole has benefited.

The education program has been beneficial as well. To date, 22 short courses have been conducted (including 10 pilot courses) with a total of 633 participants. The individuals who have participated in the short course programs have returned to their jobs with the lat-

est in best practices and with new ideas to try themselves. As the education program expands to other areas of the U.S., the opportunity for CII to provide information that can improve projects will grow. The network of regional universities that is now being established will be a key to the overall success of the education program.

It is clear that the CII research, implementation, and education efforts have made a difference in industry quality and cost effectiveness. This difference, to a great extent, has been a function of the posture of individual companies. Those aggressive in the study and application of CII concepts have been the most successful. Project teams that have taken the initiative to apply CII concepts have been notably successful.

A significant potential exists for an even greater impact on the industry as company implementation programs mature and as the CII educational program delivers its full impact to the industry. It is equally clear, however, that this success truly lies in the hands of CII member companies and those organizations in industry who are not members of CII, but who are committed to improving quality and cost effectiveness. CII has been a catalyst for a culture change wherein people in project organizations and in companies will no longer be satisfied with doing things the old way, but are encouraged to develop new and better ways of planning and executing engineering and construction projects.

Figure 12 CII Structure

Chapter 12

CII: THE FUTURE

The membership of CII continues to grow, with a total of 92 member companies as of June 1993. The growing membership is a recognition that CII's research programs, the efforts to support implementation of research results, and its educational program are all significantly contributing to the improvement of the industry.

CII believes it can continue to make a difference in the total quality and cost effectiveness of the U.S. construction industry. In 1990, the Board of Advisors established the following goals for the Year 2000:

- Reduce total project costs by 20 percent.
- Reduce project schedules by 20 percent.
- Reduce recordable injuries by 25 percent.

The original Strategic Plan was modified in 1990 to reflect the evolution of CII. In particular, the mission statement was revised by adding the words total quality so that it now reads: "The mission of CII is to improve the total quality and cost effectiveness of the construction industry through research and implementation for the purpose of providing a competitive advantage to U.S. businesses in the global marketplace."

The organizational structure, as set forth in Figure 12, reflects the growth of the implementation and education functions. The CII staff remains small with a total of 19 individuals.

Many problems lie ahead in the industry. Many unresolved issues within CII are continually being addressed by the Executive and Strategic Planning Committees as well as by the Board of Advisors. CII is committed to implementing the concepts of total quality management, both internally within the staff and in the methods that are employed by the Executive Committee as it conducts its business. The entire process for determining future research to be performed will be examined in the context of the continuous improvement process. To that end, the Executive Committee participated in TQM training sessions beginning in 1990, and continue the training activities today. The TQM approach has led to a restructuring of CII's organization and budgeting. In addition, the CII staff received TQM training in July 1993.

Clearly, there are opportunities in the liaison area to improve the methods by which CII disseminates the results of its research throughout the industry and by which it will relate to other organizations with common interests. Perhaps the current effort that has

the greatest potential for contributing to the long-term improvement of the industry is the CII education program—the program involving the preparation of educational modules and the administration of short courses based on CII research products. CII is committed to this program and believes that it is a long-term factor in the improvement of the industry.

CII was uniquely established to benefit the U.S. manufacturing industry and the U.S. construction industry as a whole, not just the CII members. CII members, however, have undoubtedly benefited more than non-members, both through earlier access to research results and through the natural networking benefits of participation. The total cost of participation is almost insignificant compared to the benefits obtained.

Since major benefits accrue to the owners, it is particularly important that owners continue to provide leadership in CII. The owners make the difference. Contractors cannot do it by themselves, and have little motivation for research unless the owners are also interested. Contractors and academics cannot identify the true high payoff research activities by themselves. A high level of owner participation will continue to be important.

The key to success will be member companies and their experienced professionals who volunteer to work on CII committees, councils, task forces, and action teams. At this time, over 800 industry participants contribute to CII efforts.

It has been said that the past is prologue, and this is particularly true for the Construction Industry Institute: the work of the future will build on the work of the past. CII believes that the challenge of the future will be met by the men and women who contribute their talents, experiences, time, and energies to the development of better ways for this industry to plan and execute engineering and construction projects.

Appendix A

THE CHARTER MEMBERS OF CII

Aluminum Company of America

Guy F. Atkinson Company of California

Atlantic Richfield Company

Bechtel Petroleum, Inc.

BE&K Construction Company

Blount International, Ltd.

Brown & Root, Inc.

Davy McKee Constructors Inc.

Dow Chemical USA

DuPont

Exxon Research & Engineering Company

Fluor Corporation

General Electric Company

Gulf Interstate Engineering

International Business Machines Corporation

Kellogg Rust Inc.

The Lummus Company

Morrison Knudsen Company, Inc.

Owens-Corning Fiberglas Corporation

The Procter & Gamble Company

Shell Oil Company

Sohio Construction Company

Standard Oil Company (Indiana)

Stearns-Roger Engineering Corporation

Texaco Inc.

Texas Eastern Corporation

Union Carbide Corporation

H. B. Zachry Company

Appendix B

CII LEADERSHIP HISTORY

Committee	Years	Chair	Company
Executive	1983-84:	Lou Garbrecht, Jr.	Texaco
	1985:	Jack J. Agresti	Guy F. Atkinson
	1986:	Robert H. Miller	DuPont
	1987:	Gary D. Jones	Morrison Knudsen
	1988:	Robert A. Valentine	General Motors
	1989:	Ted C. Kennedy	BE&K
	1990:	Joseph W. Martinelli	Chevron
	1991:	D. Keith Dodson	John Brown
	1992:	Collin D. Aikman	Union Carbide/BE&K
	1993:	Richard R. Bryan	H. B. Zachry
Strategic Planning	1984-85:	Robert H. Miller	DuPont
	1986:	Gary Jones	Rust
	1987-88:	Lou Garbrecht, Jr.	Texaco
	1989-91:	Robert H. Miller	DuPont
	1992:	James M. Braus	Shell
	1993:	Gary D. Jones	BE&K
Annual Conference	1985:	Gary D. Jones	Kellogg Rust
	1986:	Keith M. Price	Morrison Knudsen
	1987:	James M. Braus	Shell
	1988:	Ted C. Kennedy	BE&K
	1989:	Lyle F. Garcia	AT&T
	1990:	Don J. Gunther	Bechtel
	1991:	G. Brian Estes	Naval Facilities Engineering Command
	1992:	Doy F. Cole	M. W. Kellogg
	1993:	Gordon R. Denker	Procter & Gamble

CPI Conference	1986:	Jack H. Kennedy	Foster Wheeler
	1987-88:	John V. Landry	Gulf States
	1989:	Richard D. McElmoyle	Fluor Daniel
	1990:	Stephen H. Grote	Brown & Root
	1991:	Lyle F. Garcia	AT&T
	1992:	William J. Carlson	Guy F. Atkinson
	1993:	John V. Landry	Gulf States
Education	1993:	Ronald J. Charbonneau	International Paper
Finance	1986:	Manuel Peralta	Exxon
	1987:	Charles I. McGinnis	Fru-Con
	1988:	Charles D. Williams	Gilbert/ Commonwealth
	1989:	Robert A. Valentine	General Motors
	1990:	Ted C. Kennedy	BE&K
	1991:	Joseph W. Martinelli	Chevron
	1992:	D. Keith Dodson	John Brown
	1993:	Collin D. Aikman	BE&K
Implementation	1985:	John D. Chiquoine	DuPont
	1986:	J. A. Scarola	Enserch
	1987:	W. G. (Pete) Lilly	Union Carbide
	1988-89:	Stephen H. Grote	Brown & Root
	1990-92:	Richard B. Bankhead	Weyerhaeuser
	1992-93:	Joseph K. Haegelin	Texaco
Industry Communications	1992-93:	D. Keith Dodson	John Brown
Membership	1983-85:	Peter C. Forster	Blount
	1986:	Joseph G. Munisteri	Ford, Bacon & Davis
	1987:	John C. Horning	General Electric
	1988:	Joseph G. Munisteri	Ford, Bacon & Davis
		James C. Stein	Fluor Daniel
	1989:	Don J. Gunther	Bechtel

	1990:	D. Keith Dodson	Davy McKee
	1991:	Doy F. Cole	M. W. Kellogg
	1992-93:	Norman L. Strong	Marshall
Nominating	1985-86:	Lou Garbrecht, Jr.	Texaco
	1987-89:	Jack J. Agresti	Guy F. Atkinson
	1990:	Gary D. Jones	Morrison Knudsen
	1991-92:	Gary D. Jones	BE&K
	1993:	D. Keith Dodson	John Brown

Ad Hoc Committees	**Year**	**Chair**	**Company**
Benchmarking & Measurements	1993:	Robert G. White	Texas Eastman
Chinese Pipe Flanges	1993:	Urey Miller	M. W. Kellogg
Leveraging	1991:	Ted C. Kennedy	BE&K
Member Services	1991-92:	Robert A. Valentine	General Motors
TQM	1993:	J. J. Suarez	Belcan

Boards	**Year**	**Chair**	**Company**
Education Development	1991-93:	Gary J. Wilson	Texaco
Education Deployment	1993:	J. S. Bindra	Chevron
Products Review Board	1992-93:	Edward J. McGuire	Exxon

Councils	**Year**	**Chair**	**Company**
Academic	1985-86:	Sewell C. Harlin	BE&K
	1987:	Robert A. Valentine	General Motors
	1988-89:	Arnold P. Richter	IBM

	1990:	Wayne N. Clark	Texaco
	1991-93	Leonard G. Harris	Brown & Root Braun
The Business Roundtable	1985-87:	Carroll H. Dunn	The Business Roundtable
	1988-91:	Robert H. Miller	DuPont
	1991:	Collin D. Aikman	Union Carbide
	1992-93:	Shelby C. Pierce	Amoco
Contractor Associations	1985-86:	Robert H. Miller	DuPont
	1987:	James K. Addison	DuPont
	1988-89:	Joseph W. Martinelli	Chevron
	1990:	Byron Y. Sellers	DuPont
	1991:	Shelby C. Pierce	Amoco
Construction Suppliers	1988-90:	Earl B. Mills	Jones
	1991-93:	James A. Scotti	Brown & Root
Industry Liaison	1985:	John H. Cassidy	Ralph M. Parsons
	1986:	E. C. Holland	Belcan
	1987-88:	Russell J. Christesen	Ebasco
International	1989-90:	Leonard G. Harris	CF Braun
	1991-92:	Gordon L. Dibble	John Brown
Professional Societies	1988:	Joseph G. Munisteri	Ford, Bacon & Davis
	1989:	Eugene K. Ferguson	Houston Lighting & Power
	1990:	Gordon L. Dibble	John Brown
	1991:	James B. Porter, Jr.	DuPont
	1992-93:	William M. Bivens	Tennessee Valley Authority
Research Centers	1988-91:	Dennis E. Schroeder	U.S. Bureau of Reclamation
	1991:	Philip E. Flad	J. C. Penney
	1992-93:	Robert E. Fielitz	DuPont

APPENDIX B

Task Forces	Year	Chair	Affiliation
CICE Impact Evaluation	1984:	William B. Ledbetter	Clemson University
	1984-88:	Louis J. Pucher	Kellogg Rust
Productivity Measurements	1983-87:	Robert C. Volkman	Procter & Gamble
	1987-88:	Karl H. Brauer III	Brown & Root
CII Model Plant	1986-88:	Charles E. Webb	DuPont
Constructability	1983-87:	Robert F. Jortberg	Lummus Crest
	1987-88:	Anson C. Perkins	Bechtel National
Industry Data & Statistics	1983-86:	David B. Ashley	UT-Austin
	1986-90:	William G. Fischer	Mobil
Contracts	1983:	Photios G. Ioannou	Univ. of Michigan
	1984-85:	Alfred J. Iannone	IBM
	1986-88:	Isaac Pass	Exxon
Cost & Schedule Controls	1983-88:	James M. Neil	Morrison Knudsen
Materials Management	1983-86:	Robert L. Wootten	DuPont
	1986-88:	Preston L. Jones	Stearns-Roger/United Engineers & Constructors
Design	1983-85:	George O. McDaniel	Dow Chemical
	1986-89:	Graham Sutherland III	Morrison Knudsen
Technology	1984-86:	Robert H. Maass	Exxon
	1986-89:	George H. Watson	Amoco
Quality Management	1985-87:	Walter E. Scruggs	Monsanto
	1987-89:	Wallace L. Tanner	Shell

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Employee Effectiveness	1985-87:	James W. Mortell	Cherne
	1988-90:	Richard S. Troell	FMC
Project Organization	1986:	Ronald F. White	Texaco
	1987:	David A. Spivey	Corps of Engineers
	1987-90:	Leonard G. Harris	Brown & Root Braun
Safety	1985-87:	Philip R. Osterlind	Fluor Daniel
	1987-90:	G. Frank Moore	Fluor Daniel
Education & Training	1985-87:	Richard J. Hart	Blount
	1987-91:	John M. Anderson	Day & Zimmermann
Technology Survey	1988-89:	Andrew Brown, Jr.	General Motors
	1989:	C. Glenn Darnall	BE&K
	1989-93:	Conrad D'Esopo	Stone & Webster
Advanced Technological Systems	1988-92:	Jack F. Browder	Brown & Root
Construction 2000	1987-91:	Timothy S. Killen	Bechtel
Partnering	1987-89:	James W. Mortell	Cherne
	1989-90:	Hans J. Kraus	Chevron
	1990-91:	Scott T. Baker	Rust
Insurance	1988-90:	James C. Lindford	Gulf States
	1990-93:	J. Dennis Wilson	Eichleay
Electronic Data Management	1988-92:	Edward M. Ruane	J. A. Jones
Project Team Risk/Reward Allocation	1988-92:	Adrian E. Hutton	Monsanto

U.S. Navy Demonstration Project	1988-92: 1993:	William J. Sim Dean Battles	Potomac Electric Power Rust
Dispute Prevention & Resolution	1988-89: 1989-91: 1991-92: 1993:	Kevin Burke John W. Wilde G. Dennis Harris C. Andrew Miller	Con Ed of New York Ford, Bacon & Davis North Bros. Turner
Contracting, Phase II	1989-93:	Merv R. Torian	Ford, Bacon & Davis
Computer Integrated Design & Construction	1988-93:	George E. Gray	UE&C-Catalytic
Retrofit Projects	1989-93:	Walter C. Kress	American Cyanamid
Change Order Impacts	1989-92:	James R. Tacheny	Northern States Power
Construction Work Force	1989-90: 1990-91:	Richard R. Bryan Michael D. Avant	H. B. Zachry Davy McKee/Litwin
Modularization	1989-91: 1991-92:	Charles J. Hickl John M. Duty, Jr.	Dow Chemical Bechtel
International Construction	1989-91: 1991-93:	Peter R. Hassinger Stephen F. Harris	ABB Lummus Crest Brown & Root Braun
Total Quality Management	1990-93:	Charles R. McGinnis	Chevron
Zero Accidents	1990: 1990-93:	Cris E. Campos Emmit J. Nelson	Air Products Shell
Overtime	1990-91: 1992:	Hasan A. Hammami Wendell M. Hays	Procter & Gamble AMEC

Constructability Implementation	1990-92:	William A. Quade, Jr.	Naval Facilities Engineering Command
Owner Engineering Organization	1990-93:	William E. Hall	Ralph M. Parsons
Quality Performance Measurement	1990-93:	J. J. Suarez	Belcan
Project Team Building	1990-93:	Melvin Gray	Graycor
EPC Flexibility	1990: 1990-91: 1991-92:	George F. Eichleay Michael F. Knapp Dennis A. Schroeder	Eichleay Ralph M. Parsons BE&K
Pre-Project Planning	1991-93:	Thomas R. O'Neill	ABB Lummus Crest
Continuing Supervisory Education	1991-93:	M. R. Hamby, Jr.	Nat'l Industrial Constructors
Schedule Reduction	1991-93:	John A. Adamchik	AMEC
Barriers to Implementation	1991-93:	David S. Rozendale	Rust
Project Change Management	1992-93:	James C. Belote	Bechtel
Drug-Free Workplace	1992: 1993:	Michael M. Dallam Charles Edmundson	Potomac Electric Power Southwestern Bell
Workers' Compensation Insurance	1992: 1992-93:	John V. Landry Kin Tsu Ronald L. Beckman	Gulf States American Cyanamid ABB Combustion Engineering Services

Technology Strategy	1992-93:	Robert A. McNamara	Marshall
Piping Function	1992-93:	William Travers	Stone & Webster
Environmental Remediation Technology	1992-93:	Richard A. Millet	Woodward-Clyde
International Standards	1992-93:	John R. Messick	Belcan
Americans with Disabilities (ADA) Impacts	1992-93:	John R. Rivers	CUH2A
Utility Pilot Projects	1992: 1993:	Max M. DeLong Robert Alder	Northern States Power Gilbert/Commonwealth
Design for Safety	1993:	James B. Pemberton	Atlantic Richfield Co.
Partnering II	1993:	Paul Jones	Procter & Gamble
Project Organization II	1993:	Fritz Rehkopf	McDevitt Street Bovis
Proj. Team Communications	1993:	George B. Martin	Ford, Bacon & Davis
3D CAD Link	1993:	John G. Voeller	Black & Veatch
Predictive Tools	1993:	Ted W. Nelson, Jr.	Eichleay
Action Teams	**Year**	**Chair**	**Company**
Pilot Projects	1990-92:	James F. Quinn	International Paper
Marketing	1990-92:	Stuart E. Graham	Sordoni Skanska
Special Projects	1990-92:	James M. Neil	Morrison Knudsen

Plants/Divisions	1990-91:	Joseph K. Haegelin	Texaco
LUC Support	1990-91:	James R. Lowe	Weyerhaeuser
Project Management Education	1990-91:	Gary J. Wilson	Texaco
Constructability Education	1991-93:	John R. Messick	Belcan
Design Effectiveness Education	1991-93:	D. G. Shaw	Ontario Hydro
Project Organization Education	1991-93:	Joseph Torcivia	Torcon
Quality Management Education	1991-93:	Thomas E. Kelly	Weyerhaeuser
Materials Management Education	1991-93:	Clayton B. Claassen	Bechtel
Safety Education	1991-93:	Richard S. Troell	FMC
Cost & Schedule Education	1991-93:	Richard M. Hoover	Air Products
Electronic Data Management Education	1991-93:	Edward M. Ruane	J. A. Jones
Partnering Education	1992-93:	Charles R. Schroer	Corps of Engineers
Contracts Education	1992-93:	T. F. Harrington	Weyerhaeuser
Networking	1992-93:	Jim Lowe	Weyerhaeuser

Appendix C

CII TASK FORCES

CII uses the acronym TOPICS to describe the research effort. TOPICS signifies the six research thrust areas: Technology, Organization, People, Information, Controls, and Sigma (meaning others). The historical listing of the task forces for each thrust area is presented below:

Technology

- Advanced Technological Systems
- Computer Integrated Design & Construction
- Constructability
- Design for Safety
- Electronic Data Management
- EPC Flexibility
- Environmental Remediation Technology
- Modularization
- Technology
- Technology Strategy
- Technology Survey

Organization

- Constructability Implementation
- Management of Project Changes
- Partnering
- Partnering II
- Project Organization
- Project Organization II
- Project Team Building
- Project Team Risk/Reward Allocation

People

- Americans with Disability
- Construction Work Force
- Drug-Free Workplace
- Education and Training
- Employee Effectiveness
- Safety
- Zero Accidents

Information

- 3D CAD Link
- CICE Impact Evaluation
- Industry Data & Statistics
- International Construction
- International Standards
- Model Plant
- Owner Engineering Organization
- Project Management Assessment Survey
- Project Team Communications

Controls

- Change Order Impacts
- Contracting, Phase II
- Contracts
- Cost/Schedule Controls
- Design
- Dispute Prevention and Resolution
- Materials Management
- Overtime
- Overtime, Phase II
- Predictive Tools
- Productivity Measurements
- Quality Management
- Quality Performance Measurement
- Total Quality Management

Sigma

- Construction 2000
- Insurance
- Piping Function
- Retrofit Projects
- U.S. Navy Demonstration Project
- Workers' Compensation

CII ACTION TEAMS

The CII Action Teams are part of the implementation effort. Provided below is the historical listing of the action teams:

Constructability Education
Continiuing Education Short Course
Contracts Education
Cost and Schedule Education
Design Effectiveness Education
Electronic Data Management Education
Local User Councils
Marketing
Materials Management Education
Partnering Education
Pilot Projects
Plants/Divisions
Project Organization Education
Quality Management Education
Safety Education
Small (Special) Projects

Appendix E

ORGANIZATIONS REPRESENTED ON CII COUNCILS

Air Force Civil Engineering Laboratory

Associated Builders and Contractors

Associated General Contractors of America

American Association of Cost Engineers

American Chemical Institute

American Institute of Architects

American Institute of Chemical Engineers

American Society of Civil Engineers

American Society of Mechanical Engineers

American Welding Society

Industry Applications Society

Institute of Electrical and Electronic Engineers

Mechanical Contractors Association of America

National Association of Women in Construction

National Electrical Contractors

National Society of Professional Engineers

Naval Civil Engineering Laboratory

Project Management Institute

Society of American Military Engineers

Sheet Metal and Air Conditioning Contractors of America

The Business Roundtable

U.S. Army Construction Engineering Research Laboratory

ACADEMIC INSTITUTIONS

Arizona State University

Carnegie Mellon University

Clemson University

Colorado School of Mines

Colorado State University

East Carolina University

Georgia Institute of Technology

Iowa State University

Lehigh University

Louisiana Tech University

Massachusetts Institute of Technology

North Carolina State

Oklahoma State University

Oregon State University

Pennsylvania State University

Polytechnic Institute of New York

Purdue University

Stanford University

Stevens Institute

Texas A&M University

University of California, Berkeley

University of Colorado

University of Houston

University of Illinois

University of Kentucky

University of Michigan

University of New Mexico

The University of Texas at Austin

University of Washington

University of Wisconsin-Madison

Virginia Polytechnic Institute

Worcester Polytechnic Institute

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CII MEMBERSHIP

AT&T
Aluminum Company of America
American Cynamid Company
Amoco Corporation
Anheuser-Busch Companies, Inc.
Aramco Services Company
Atlantic Richfield Company
BP Oil Company
Chevron Corporation
Consolidated Edison Company of New York, Inc.
Dow Chemical U.S.A.
DuPont Co.
Eastman Chemical Company
Elf Atochem North America Inc.
Eli Lilly and Company
Exxon Research & Engineering Company
FMC Corporation
General Electric Company
Glaxo Inc.
Hoechst Celanese Corporation
Hoffman-LaRoche, Inc.
Houston Lighting & Power Company
ICI Americas Inc.
International Paper Company
Lever Brothers Company
Merck & Co., Inc.
Mobil Corporation
Monsanto Company
Naval Facilities Engineering Command
Northern States Power Company
Ontario Hydro
Phillips Petroleum Company
The Procter & Gamble Company
Rohm and Haas Company
Shell Oil Company
Southwestern Bell Telephone Company
Tennessee Valley Authority
Texaco Inc.
U.S. Department of Defense
U.S. Department of State
Union Carbide Corporation
Weyerhaeuser Company

ABB CE Services, Inc.
ABB Lummus Crest Inc.
AMEC Holdings, Inc.
Guy F. Atkinson Company of California
BE&K Construction Company
The Badger Company, Inc.
Bechtel Group, Inc.
Belcan Engineering Group, Inc.
Black & Veatch Engineers-Architects
Bovis, Inc.
Brown & Root, Inc.
John Brown E&C
Burns & Roe Enterprises, Inc.
CRS Sirrine Engineers, Inc.
CUH2A Architects/Engineers/Planners
Cherne Contracting Corporation
Cianbro Corporation
Day & Zimmermann Inc.
Dillingham Construction Holdings Inc.
Ebasco Constructors Inc.
Eichleay Holdings Inc.
Fletcher Construction Company Ltd.
Fluor Daniel, Inc.
Ford, Bacon & Davis, Inc.
Foster Wheeler Constructors, Inc.
Fru-Con Corporation
Gilbane Construction Company
Gilbert/Commonwealth, Inc.
Graycor, Inc.
Gulf States, Inc.
Huber, Hunt & Nichols, Inc.
International Technology Corporation
J. A. Jones Construction Co.
Jacobs Engineering Group
The M. W. Kellogg Company
Litwin Engineers & Constructors, Inc.
Marshall Contractors Inc.
Morrison Knudsen Company, Inc.
North Bros. Company
The Parsons Corporation
Rust International Corporation
S&B Engineers and Constructors Ltd.
Sargent Electric Company
Sordoni Skanska Construction Company
Stone & Webster Engineering Corp.
Sverdrup Corporation
Torcon, Inc.
Turner Construction Company
United Engineers & Constructors International
Woodward-Clyde Consultants
H. B. Zachry Company

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