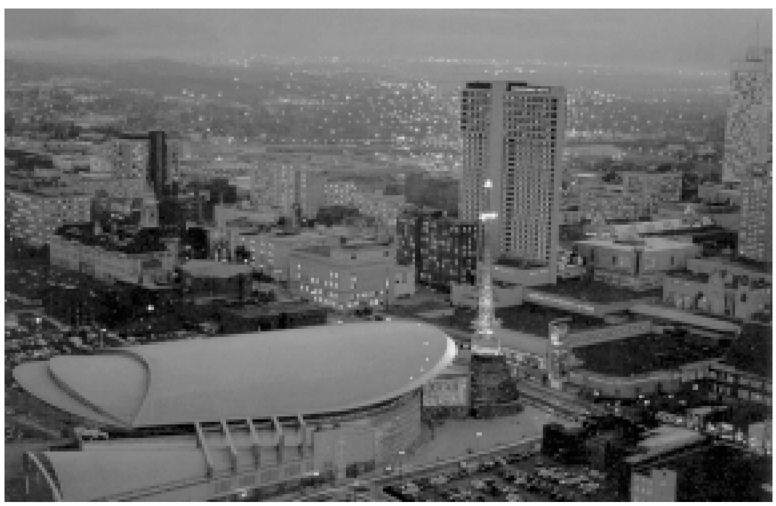
Construction Industry Institute
2000 Annual Conference

Conference Proceedings



Leading the Knowledge Revolution in the Construction Industry

Nashville, Tennessee

CII Member Companies

3M
Abbott Laboratories
Air Products and Chemicals
Aluminum Company of America
Anheuser-Busch Companies
Aramco Services Company
Bayer Corporation
BP Amoco Corporation
Cargill
Celanese
Champion International Corporation
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BMW Constructors
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Graycor
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Hilti Corporation
Honeywell International
Integrated Electrical Services
International Technology Corporation
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Kiewit Construction Group
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M. A. Mortenson Company
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Parsons Energy & Chemicals Group
Petrofac LLC
Primavera Systems
Rust Constructors
SAP America
S&B Engineers and Constructors Ltd.
Stone & Webster Engineering Corporation
Walbridge Aldinger Company
H. B. Zachry Company

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August 9–10, 2000

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Leading the Knowledge Revolution in the Construction Industry

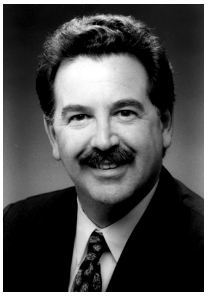
Keynote Speech: Michael D. Beebe

Abstract

Global connectivity and an unprecedented flow of information are two of the elements that make the Internet Age richer and more challenging than any that have come before. Success in this new economy depends on the efficient use, reuse, and sharing of the information that surrounds us — Knowledge Management makes this possible.

CSC, a recognized leader in the field, is using Knowledge Management to transform its IT services and consulting business. Using CSC's own history and aggressive adoption of Knowledge Management techniques and technologies as an example, Mr. Beebe will examine the power of the knowledge-intensive environment, describe the enabling technologies, and explore the revolutionary impact and benefits Knowledge Management can bring to the construction industry.

Keynote Speaker



Mike Beebe is president of Computer Science Corporation's North American Consulting Group. He is responsible for service delivery to the group's global clients. He was previously president of CSC's Chemical & Energy Group, where he was responsible for overall delivery to CSC's clients in the industry segment on a global basis. Prior roles have included responsibility for delivery to the DuPont Corporation, and creation and support of partnerships with Hughes Aircraft Company, General Dynamics, and Sun Microsystems.

Prior to joining CSC, Mr. Beebe was vice president, data systems division of General Dynamics and before that held various information technology and business roles including a four year assignment in Europe as a financial manager.

Mr. Beebe has been with CSC for eight years. Van B. Honeycutt, CSC's chairman, president and CEO, recently said that Beebe's global perspective and experience with all of CSC's lines of service are essential as CSC draws upon its global resources and best practices to provide seamless solutions, including the use of e-business technologies, to clients' IT needs.

CSC's Consulting Group provides a wide range of strategic and management consulting and systems integration services to clients in the commercial and government markets. The group has approximately 4,600 employees.

Computer Sciences Corporation helps clients in industry and government use information technology to achieve strategic and operational objectives. With 57,000 employees in more than 700 offices worldwide, the company tailors solutions from a broad suite of integrated service offerings, including e-business strategies and technologies; management and IT consulting; systems development and integration; application software; and IT and business process outsourcing.

FIATECH —
Bringing High Technology to Capital Facilities
Breakthrough Strategy Committee

Learning Objectives

- Consider how technology has reduced the cycle time in other industries and the potential economic benefits of FIATECH developed systems and technologies to the construction industry.
- See how FIATECH can substantially leverage scarce R&D dollars while pooling talent and spreading the risks.
- Discover why the goal of reducing total installed costs and cycle times by 40% is realistic.
- Learn more about FIATECH and why your company should join the challenge.

Abstract

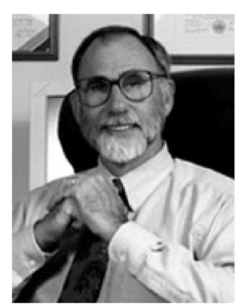
Fully Integrated and Automated TECHnology is a CII breakthrough initiative — a coordinated effort of owners, contractors and suppliers who realize that fully integrated and automated project processes, or FIAPP, will provide facilities that are a more strategic element of the owners' business model. Simply stated, FIATECH will make FIAPP a reality and will have the power to revolutionize the construction industry.

Plenary Session Presenters

K. Keith Roe – Chairman, President, and CEO of Burns and Roe Enterprises.

K. Keith Roe is Chairman, President, and CEO of Burns and Roe Enterprises, an international engineering and construction company headquartered in Oradell, New Jersey. He has been with the firm since 1974, and has served in a variety of project management positions in the home office, branch offices, and at field site locations. He is Chairman of the Board of Trustees of the American Society of Mechanical Engineers (ASME) Foundation and has served on the Visiting Committee for the Department of Nuclear Engineering at MIT. He earned a bachelor's degree in mechanical engineering from Princeton University, has a master's and engineer's degree in nuclear engineering from MIT, and is a Registered Professional Engineer in New York, New Jersey, and Puerto Rico.

Richard H. F. Jackson – Director, FIATECH



Dr. Richard H. F. Jackson is the first Director of FIATECH, the new consortium launched this year by CII. He previously was the Director of the Manufacturing Engineering Laboratory at the National Institute of Standards and Technology. He was frequently called upon to represent the U.S. Government in international and national arenas. He has published over 100 technical papers and reports in the fields of mathematical modeling, nonlinear optimization, automated manufacturing, and technology transfer.

Ric holds a bachelor's degree from Johns Hopkins University, a master's degree from Southern Methodist University, and a doctorate from George Washington University.

Implementation Session Moderator

Richard H. F. Jackson, Director – FIATECH

Implementation Session Panelists

Robert E. Donaho, Manager of Design/CAE **–** The Dow Chemical Company

Daniel J. Maas, Chief Technical Director **–** National Center for Manufacturing Sciences

K. Keith Roe, Chairman, President & CEO **–** Burns & Roe Enterprises

Jack E. Snell, Director **–** Building & Fire Research Laboratory, U.S. Department of Commerce/NIST

FIATECH —
Bringing High Technology to Capital Facilities

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FIATECH —
Bringing High Technology to Capital Facilities

Plenary Slides

CII Use of Technology-Assisted Learning

Education Committee and Technology-Assisted Learning Research Team

Learning Objectives

- Become aware of CII's Technology Assisted Learning product.
- Understand the contents of TAL.
- Know how to sign on to receive TAL materials.
- Increase your options for training your Project Personnel/Team.
- Raise the awareness of CII benefits among your senior business managers.

Abstract

This presentation will describe the new CII Technology Assisted Learning (TAL) program and how it can help you implement CII research results, train your people on CII practices, and raise the awareness within your company of valuable benefits made available by CII. The research to determine the potential for improving the delivery of CII education was conducted under the guidance of the CII Education Committee. A summary of the research findings will be presented. In addition you will learn how the research findings are being implemented at CII and how you can access the CII TAL system for your project execution professionals. The presentation will explain how TAL can be used for stand-alone training available around the clock, around the world and how it can be integrated into the campus based training programs to reduce students' time away from the job.

The Plenary Session presentation will identify those CII training modules currently available as TAL modules and those planned for conversion in the near future. The Implementation Session will feature a demonstration of the TAL Constructability Module and how you can sign up for a free Test Drive of the CII courses and up to 100 other courses on a variety of subjects. You will also hear from experienced users of Web-based training.

Plenary Session Presenter

E. Charles Brod – General Project Manager, Union Carbide Corporation.

Charles Brod is a General Project Manager for Union Carbide Corporation in Sugar Land, Texas. During his 41 years with Union Carbide, he has had assignments in Plant Operations, Process Engineering, and Project Management. He has led capital projects at every Union Carbide domestic plant, as well as those in England, France, and Italy. He has worked with CII for several years, having served on the Education Committee and having been a member of both the Project Team Building Research Team and the Owner/Contractor Work Structure Research Team. In his most recent CII position, Charles served as chair of the Technology-Assisted Learning Research Team. He holds a mechanical engineering degree from Texas A&M University.

Implementation Session Moderator

Michael M. Cate – Director, Procurement and Contracts, Morrison Knudsen Corporation.

Mike Cate is Director, Procurement and Contracts, for Morrison Knudsen Corporation in Cleveland, Ohio. He has been with MK for the past 34 years, with wide-ranging experience, including both foreign and domestic assignments. Mike has had functional responsibilities from project management to management of the procurement department, as well as responsibility for group contract administration supporting four operating divisions. He has been active in CII since the 1980s, serving on CII research and education teams, various committees and councils, and has been an Annual Conference presenter. He holds an electrical engineering degree from the University of Tennessee.

Implementation Session Panelists

E. Charles Brod, General Project Manager – Houston Engineering Office, Union Carbide Corporation

Barry Fox, Information Systems Section Leader – Celanese Chemicals

William Lidwell, President & Chief Executive Officer – KnowledgeWire

Andre Siegenthaler, Vice President, Human Resources – Hilti Corporation

CII Use of Technology-Assisted Learning

Education Committee and Technology-Assisted Learning Research Team

Presentation Summary

Historically, CII education materials have consisted mainly of written lesson plans designed for use in the CII Education Short course programs conducted in traditional classroom settings. The lesson plans are also available for sale to member companies and others for use in presenting CII research content in house. Due to lost productivity and the cost of travel for off-site training, companies are reducing their use of classroom training. In addition, the pervasive use of computers and other electronic media has created a growing need for quicker delivery of education material with an emphasis on the technology that is available today.

The CII Education Committee conducted Education Needs Surveys in 1995 and 1997. The survey responses from CII members identified a strong interest in computer-based training. In response to this member interest, the Education Committee sponsored it's first Research Team and chartered it to survey the training industry for trends in electronic delivery of training materials and to identify opportunities for utilizing the technology in the delivery of CII research to member companies.

The research team conducted an additional survey of member companies that had shown interest during the earlier surveys to confirm the trend to electronic-based training and to assess the feasibility of utilizing technology assisted learning in their companies. The team also investigated current and future trends within the training industry for the delivery of training materials. Finally, the team identified and evaluated a number of delivery methods for training and for dissemination of information.

The information gathered was evaluated and a methodology called Technology Assisted Learning (TAL) was developed for the conversion of selected CII Training Modules into Web-based modules that can be delivered over the internet around the clock to any location worldwide. The research team recommended KnowledgeWire as the service provider to assist in the conversion of CII material into Web-based modules and to provide the Internet delivery system.

Findings, Applications, and Conclusions

Findings: The research team found that most CII member companies were already using intra/internet communication and the infrastructure was already in place to support TAL delivery. In addition to finding an existing technical infrastructure, the team also determined that there were no major policy or administrative barriers that would interfere with the use of Internet-based training.

The Internet is becoming, if not already, the major conduit for delivering information of all types and everyone is becoming comfortable with its use. CII must expand beyond offering only print-based education material if it is going to remain a reliable source of training on best practices for capital project delivery.

The TAL system provides for Internet delivery of CII training, access to over 100 other courses available through KnowledgeWire and a course management system.

Applications: TAL brings CII education material directly to your desk top via an effective and highly interactive software program that can be accessed at any time from any location in the world. Courses are developed in a collaborative effort between CII subject matter experts and KnowledgeWire module builders using a proven interactive work process. Access to the KnowledgeWire site is gained by purchasing a license for each student for $50.00 per year. The license entitles the student access to all CII courses as well as access to over 100 other courses on the KnowledgeWire system.

TAL can be used to provide pre-work for the traditional training programs, complete training on selected subjects or for overview training for those not requiring in-depth training. TAL supports and expands present CII training modes. Many of the existing education modules can be converted to TAL modules.

Conclusions: The research team concludes that:

- Many existing education modules are suitable for conversion to TAL.
- TAL will enhance implementation of CII research.
- Education modules selected for conversion to TAL should have certain characteristics which include.
- High “how-to” content.
- Tools or aids.
- High market demand.
- Significant benefits from implementation.
- Easier implementation with TAL.
- Steps or methods of implementation.
- TAL can be used effectively to present course content as a prerequisite for campus-based workshops.
- TAL will raise the awareness level of CII research value within member companies.

Recommendations: The research team recommends that:

- CII should implement TAL as part of the CII education program.
- TAL should be administered by the Education Committee.
- KnowledgeWire should be contracted by CII as the TAL service provider.
- A “critical mass” of education modules should be converted to TAL within two years.

Current Status

As a result of the report from the research team, the CII Board of Advisors approved proceeding with the development of the TAL system. CII is moving forward in the development and fielding of Web-based training, or TAL.

The Web-based training firm involved in both training development and Web hosting that CII has selected to host the CII Technology Assisted Learning is KnowledgeWire, LLC. The KnowledgeWire offices are located in Houston, Texas, in the Clear Lake area.

The agreement with KnowledgeWire is complete and has been signed. KnowledgeWire currently provides Web-based training for more than 100,000 subscribers, with a library of approximately 100 courses. A listing of the courses currently available from the KnowledgeWire library is attached.

This year CII will convert at least three of the current education modules to Technology Assisted Learning courses that will be made available through KnowledgeWire. The courses programmed for conversions to TAL format in 2000 are Implementing Constructability, Construction Safety: Zero Accidents, and Planning for Startup. If resources become available, Pre-Project Planning and Alignment may also be converted in 2000. Additional courses recommended by the Education Committee for conversion in 2001 are Project Scope and Change Management, Building the Project Team, and Optimizing Owner/Contractor Competencies for Project Success (Owner/Contractor Work Structure).

Access to the KnowledgeWire courses is obtained through an annual license for each individual accessing the material. The subscription agreements will be arranged directly between the CII member organization and KnowledgeWire. The basic license fee is only $50 per year, per person, and enables the subscriber to access the KnowledgeWire courses at any time through any Internet connection. For CII member organizations, our agreement provides for all employees with a current KnowledgeWire license to access also the CII courses at no additional charge. Non-members who purchase the standard KnowledgeWire license for $50 may access the CII courses by paying an additional $250 annually.

A feature included in the KnowledgeWire service is a training management system that enables each corporate administrator to assign training objectives in the form of courses to be completed by specific dates to individuals or sub-elements, and to track the activity and completion of those courses electronically.

For a small additional charge, member organizations may customize the standard CII course material to include changing the terms used, adding or deleting procedural steps or other changes. The customized courses will be available only to the sponsoring corporation. The customized course will be offered automatically to any member of that organization possessing a current KnowledgeWire license, when they log in to access the training.

CII will receive revenue from KnowledgeWire to offset the costs of education module development and the conversion to TAL format. This revenue will consist of 80% of the non-member license fees to access CII material, a royalty for the use of CII courses based on the ratio of use of the CII-provided courses to the total use of all KnowledgeWire courses during the quarter, and a 10% commission on the gross revenues to KnowledgeWire from new business generated by CII member organizations.

KnowledgeWire Courses Currently Available

KnowledgeWire® Enterprise Solutions is a suite of online training solutions for business and industry. The service is available via the Internet, or over private virtual connections when performance and security are paramount. It is available 24 hours a day, 7 days a week, from anywhere in the world. A list of courses that are currently available are listed below:

Access to Employee Exposure and Medical Records

Millions of employees are exposed to hazardous substances in the workplace each year. In the United States, employees, or their designated representatives, have a right to access information about this hazardous substance exposure, and all medical records associated with that exposure.

In this course, participants will gain an understanding of the potential health effects from exposure to chemicals. This yields direct and indirect benefits for the detection, treatment, and prevention of occupational disease. Participants will also learn about medical records and their importance, about record storage requirements, as well as employees' rights to access these records.

Active Listening Skills

Listening is one of the most important skills for success in life, but it is taken for granted by most people.

In this course, participants will learn how to improve their active listening skills, and gain an understanding of the significance of listening. Practicing the seven listening skills presented will help participants increase their productivity, as well as improve their ability to work with others.

Americans with Disabilities Act

This course helps managers and supervisors to understand the Americans with Disabilities Act, a complicated and sometimes vague law. In this course, managers will learn who is classified as a disabled employee, and how these employees are protected under the ADA in the workplace. This course also covers what types of accommodations for these employees are considered reasonable in the modern work environment.

Asbestos Awareness

Asbestos is a naturally occurring material, which has been determined to cause cancer, as well as other potentially serious health problems. With proper training, people who work with asbestos can avoid these negative health effects. This course will help participants learn to identify the work activities where asbestos exposure may occur. Participants will also learn the adverse health effects associated with exposure, and how they can protect themselves in the workplace.

Basic Radiation Awareness

The general public often thinks radiation exposure only occurs in areas displaying “Caution: Radiation” or “Danger: Radiation” signs. Actually, in addition to exposure in certain workplaces, each of us is exposed to natural radiation each day of the year.

This course presents information about the types of natural and manmade (ionizing) radiation, as well as where radiation originates, its health effects, principles of protection, and components of an effective Radiation Protection Program.

Basics of Business Finance

The purpose of corporate financial management is to get everyone pulling together to create value. No company can succeed if its people lack skills in managing its money and assets.

After completing this course, participants will understand the fundamentals of corporate finance in simple, easy to understand terms, and see how work activities can and do affect the financial health of an organization.

Benzene

Benzene poses a wide variety of hazards to exposed workers, ranging from mild health effects such as dry skin, to chronic diseases such as leukemia.

This course teaches participants about the various hazards associated with exposure to benzene, the methods used to detect its presence or release, medical surveillance requirements, and information on the benzene regulation.

Bloodborne Pathogens

There are a wide variety of occupations involving risk of exposure to bloodborne pathogens. Risks include hepatitis, AIDS, and other infectious diseases.

In this course, participants will learn the sources of bio-hazardous substances, and the routes of transmission and symptoms of bloodborne diseases. This course also covers the proper techniques and equipment for personal protection, and the actions to be taken following a possible exposure, as well as the components of an effective Exposure Control Plan

Body Mechanics for Healthcare Workers

The Bureau of Labor Statistics reports that up to 67% of healthcare worker injuries in the United States are due to strains and sprains, and 44% are back injuries. Most of these injuries could be prevented through changes in body mechanics, and a regular flexibility and strengthening program to increase body fitness.

This course presents information about how to improve your overall body fitness and how to protect yourself from healthcare work tasks injuries.

Building Customer Loyalty

No company can succeed if it cannot attract and keep loyal customers. This course teaches the skills needed by employees at all levels of a company to create loyalty, and to impact the company's profitability in a positive way.

Participants in this course will learn the importance of customer loyalty to them personally as well as to the company. Other topics covered in the course include customer turnoffs, how to deal with upset customers, and how to solidify customer relationships by exceeding expectations.

Combustible and Flammable Liquids

Combustible and flammable liquids are silent hazards. Many fires and explosions are either caused by these liquids, or fueled by them.

Participants in this course will learn how to recognize combustible and flammable hazards, and learn safety precautions for storage of combustible and flammable substances. They will also learn emergency response procedures and how to handle, dispense, and transport combustible and flammable liquids.

Compressed Gas

Compressed gases pose many potential hazards to humans and the environment. In addition to toxic effects from the gas, the cylinders that contain these gases can become projectiles if damaged.

In this course, participants learn about common hazards of compressed gases, as well as about leak response procedures and safe methods for handling and storage of gas cylinders.

Computer Workstation Safety

Millions of injuries associated with computer workstations are reported each year. One recent estimate quoted that as many as 1.8 million workers have carpal tunnel syndrome, a condition affecting the nerves within the arm and wrist. While a decline in these injuries has been documented in some studies in recent years, the number of people and amount of time spent using computers is increasing, both at work and at home. In this course, you will learn the symptoms and causes of Repetitive Stress Injuries (RSIs) associated with computer workstations, and how these injuries can be prevented.

Confined Space

Many work sites contain spaces that are considered “confined.” Employees who work in confined spaces face increased risk of injury or death due to oxygen deficiency or toxic atmospheres.

In this course, participants will learn the potential hazards of a confined space, procedures for confined space entry, and how to recognize a confined space.

Customizing a KnowledgeWire® Course

One of the most revolutionary aspects of KnowledgeWire® courses is the ease in which they can be modified to meet your company and site-specific needs. This not only saves your company time and money, it also results in more effective, relevant instruction.

In this course, participants will learn how KnowledgeWire® courses are organized, as well as the simple and affordable five-step process used to customize KnowledgeWire® courses.

Diversity in the Workplace

By the year 2000, eighty-five percent of the American work force will be composed of women and minorities. This course is designed to create a greater awareness of how culture influences values, assumptions, thought processes, and work relationships. Participants will learn how to succeed in this changing environment, and how to improve their working relationships with people from different backgrounds.

DOT Employee Drug and Alcohol Awareness

Alcohol and drug abuse costs over $30 billion each year in the United States from excessive sick leave, absenteeism, low productivity, injuries, and increased health insurance costs. Employers in transportation industries are required to follow specific guidelines for drug and alcohol policies, and to maintain education and testing programs for their employees in safety-sensitive positions.

Participants in this course will learn drug and alcohol awareness information that DOT requires as a part of an overall substance abuse program. They will also learn the symptoms of drug and alcohol use, and will understand what to expect if they are an employee covered under a DOT program

Electrical Safety

Electricity is the most common form of energy in the workplace. This course presents basic principles of electricity, as well as safe practices for working with it. Participants will learn to identify hazards and respond correctly to electrical emergencies.

Emergency Preparedness for Healthcare Workers

The primary goal of healthcare facilities is the preservation of life. When emergency situations arise, this goal is compromised, and certain measures must be implemented to deal with unexpected events. Many types of emergencies can occur in healthcare facilities.

This course covers the different types of emergencies and the general procedures that employees should follow in addition to their site-specific emergency response plans. It should be taken in conjunction with the Fire Safety for Healthcare Workers and Fire Extinguishers courses.

EPA Inspections

In a typical year, the federal Environmental Protection Agency (EPA) and state environmental enforcement agencies conduct over 90,000 inspections throughout the United States. In fiscal year 1995, these inspections resulted in over $94 million in criminal, civil, and administrative penalties. The goal of these inspections is to ensure compliance with laws enacted to protect both the environment and employees from toxic and hazardous waste.

In this course, participants will learn the types of EPA inspections, and the criteria used for selecting companies for inspection. They will also receive an overview of the inspection process, and the basic legal rights a company has when an inspector shows up at its front gate.

Excavations

Excavations are performed thousands of times a day across the United States. Unfortunately, thousands of people are also killed by cave-ins and accidents in excavations each year. These incidents can happen in seconds, virtually unnoticed. This course presents information on how to perform excavations properly to avoid the special hazards related to this type of work.

In this course, participants will learn information on excavations including the types of hazards involved, the role of a competent person, and the personal protective equipment required. The causes of cave-ins and means of preventing them will also be examined.

Fall Protection

At some time in our lives, each of us has experienced a sudden, unanticipated gravity-driven descent in space — better known as a fall. Falls are a leading cause of accidents on construction sites, killing more than 200 and disabling over 100,000 workers each year. Almost every workplace has jobs that put workers at risk of falling. This course presents information about the hazards of falls, and specific requirements for fall protection.

Family Medical Leave Act

This course helps managers and supervisors in understanding the Family Medical Leave Act. Managers will learn who is protected under FMLA, and how the Act protects jobs in certain employee situations. Examples are also provided of situations where employees are protected under Family Medical Leave.

Fire Extinguishers

Each year more than 4,500 Americans die and more than 30,000 are injured in fires. Many of these tragedies could have been prevented.

Participants in this course will learn the components of fire, the appropriate response to fire, and classifications for fires and fire extinguishers. This course also covers the selection, proper use, and maintenance of portable fire extinguishers

Fire Prevention

Losses from workplace fires in the U.S. in 1991 totaled $2.2 billion. Of the 4,200 persons who lost their lives to fire in 1991, 327 were workplace deaths. Fires and burns accounted for 3.3 percent of all occupational fatalities.

The primary goal of this course is to reduce or eliminate fire hazards in the workplace. Both large and small fires can cause injury and death, interrupt production, and destroy equipment and facilities. Participants in this course will learn about different types of fires and their causes, ways to prevent fires in the workplace, and the components of an effective fire prevention plan.

Fire Safety for Healthcare Workers

Fire safety in the healthcare industry is big business, with millions of dollars spent on healthcare facility design to reduce the risks associated with fire. Unlike many typical work environments, there are patients and visitors in health facilities who must be evacuated along with the employees. This course presents information about specific aspects of fire prevention relating to healthcare settings. These include fire components and prevention, healthcare design regulations, responding to a fire, and healthcare facility fire plans. This course should be taken in conjunction with the Fire Extinguishers course

First Aid

Other employees can be the first line of defense in giving assistance to injured people when an emergency arises at the workplace.

This course will prepare participants to perform emergency care, which can be given before emergency medical services (EMS) arrive. Participants will learn the initial actions they should take, as well as the proper first aid treatment for heart attacks, bleeding, shock, burns, an object in someone's eye, nosebleeds, and heat and cold emergencies.

Fitness for Work

Of the 1.8 million workplace injuries involving muscles and bones in the U.S. in 1996, 95% occurred as a result of poor fitness and poor body mechanics. It is estimated that most of these injuries could be prevented through changes in body mechanics, and a regular flexibility and strengthening program to increase body fitness. This course presents information about how posture, body mechanics, and flexibility improve your health and reduce your chance of injury.

Forklift Safety

Operators of forklift trucks must adhere to strict operating and inspection guidelines. This course teaches safe operation and inspection methods applicable to forklifts, tractors, platform lift trucks, and motorized hand trucks, as well as other specialized industrial trucks powered by liquid petroleum (LP), electric motors, or internal combustion engines.

Formaldehyde

Formaldehyde is a chemical used widely in manufacturing, agriculture, and various other industries. Exposure to as little as 25 parts per million can cause serious injury or death. Participants in this course will learn the hazards of formaldehyde, the location of resources for information on formaldehyde, measures to protect against exposure, and the requirements for medical surveillance.

Glutaraldehyde

Glutaraldehyde is a chemical used widely as a preservative, disinfectant, and sterilizing agent. Exposure to as little as 0.1 PPM (parts per million) in air can cause eye and respiratory irritation, and dermatitis. This course presents information about the hazards of glutaraldehyde, as well as information resources, and methods to protect against the effects of glutaraldehyde.

Hazard Communication

Employees exposed to chemicals in the workplace are at significant risk for adverse physical effects. This risk can be greatly reduced when employees are trained in hazard identification and prevention.

Participants in this course will learn the hazards of chemicals, chemicals' routes of entry, the effects of chemical exposure, how to read and understand chemical labels and MSDS sheets, how to detect and handle hazardous substances properly, and the special requirements of the hazard communication standard.

Hazardous Waste Determination

In 1995, approximately 208 million tons of municipal solid wastes were generated in the United States. This equates to an average of 4.3 pounds of solid waste per person each day. In addition, there was 279 million tons of hazardous waste produced by nearly 20,000 sources in that same time period. The US Environmental Protection Agency (EPA) regulates hazardous wastes through the Resource Conservation and Recovery Act (RCRA), which was passed by Congress in 1976.

In this course, participants will learn how solid waste is defined, what may be contained in a solid waste inventory, and how hazardous waste determinations are made.

Hazardous Waste Disposal

In 1995, over 16 million tons of hazardous waste was shipped in the U.S. by close to 20,000 transporters. Under the authority of a federal law known as the Resource Conservation and Recovery Act (RCRA), the United States Environmental Protection Agency (EPA) requires industries to track the generation, shipment, and disposal of hazardous wastes. These wastes are accompanied by specified forms that not only track the waste, but also help keep generators and transporters as well as Treatment, Storage and Disposal Facilities (TSDF) in compliance.

This course presents the procedure for tracking the disposal of hazardous waste from a hazardous waste generator to a TSDF.

Hazardous Waste Drum Management

Drum containers are commonly used in industry for storage, transportation, and disposal of hazardous waste. They are mobile and less expensive than many other types of storage. They also provide a convenient way to manage different types of hazardous substances over time. Despite the benefits of these drums, improper management or incorrect handling can result in the release of hazardous substances, which can cause illness and injuries.

This course presents basic information on hazardous waste drum management. Participants will learn how to select, handle, label and store hazardous waste drums properly.

Hazardous Waste Forms

In 1995, over 16 million tons of hazardous waste was shipped in the U.S. by close to 20,000 transporters. Under the authority of a federal law known as the Resource Conservation and Recovery Act (RCRA), the United States Environmental Protection Agency (EPA) requires industries to track the generation, shipment, and disposal of hazardous wastes.

In this course, participants will learn about RCRA regulations on using Uniform Hazardous Waste Manifest forms for hazardous waste shipments. This course also covers requirements of Land Disposal Restrictions, and completion of Biennial Reports.

HAZWOPER Awareness

Millions of Americans are exposed to hazardous chemicals in their workplace every day. Spills and leaks of these hazardous substances can place employees in jeopardy if they do not know how to respond. Whether the job is in a factory, at a construction project, or along highways and railroads, employees must be trained to react appropriately to the presence of hazardous substances.

This course teaches the participant how to identify hazardous substances, and how to notify a trained Hazardous Material Response Team of an unplanned or accidental release.

Hearing Conservation

The ability to hear is important in everyday life, and is particularly important for safety in the workplace. In this course, the participant will learn how to reduce the risk of sound-induced hearing loss. Participants will also learn how hearing loss occurs, how hearing can be monitored, and methods for protecting their hearing.

Heat Stress

Of all the deaths attributed to natural or weather-related phenomena (heat, cold, lightning, hurricanes, tornadoes, floods, or earthquakes), only cold weather takes a greater toll than heat. In this course, participants will learn what heat stress is, and how to recognize it. They will also learn about the immediate and long-term health hazards of heat, how the body handles heat, the factors contributing to heat stress, and controls to reduce heat stress.

Hiring and Firing

Employee selection and termination skills are essential for today's managers. Hiring is an important factor in creating a solid workforce, and firing is a tool to ensure a productive workforce. This course provides techniques for making good hiring decisions, terminating employees in a consistent and fair manner, and avoiding lawsuits in the hiring and firing process.

Hoists and Rigging

The mishandling of materials is the single largest cause of accidents and injuries in the workplace. One of the most common ways to handle materials is with hoists and rigging equipment. Unfortunately, without proper use and care, many workers lose control of hoisted loads, resulting in injury, death, and damage to expensive products and equipment. This course describes the function of hoists and their rigging and how to safely use this equipment.

Hot Work Permits

Many people think of hot work as routine welding in a protected area. In fact, many hot work operations take place outside welding shops, where protection from high heat sources is limited. Hot work permits ensure that all employees performing hot work eliminate fire hazards in their work area. Participants will learn the process of hot work area evaluation, and the contents of a hot work permit. They will also learn the responsibilities of management, workers, and fire watch personnel.

Hydrogen Sulfide (H_2S)

Millions of people are exposed to the chemical hydrogen sulfide in their work environment every day. This chemical can occur naturally, as well as in man-made processes. Hydrogen sulfide poses a wide range of hazards to exposed workers, from mild health effects (such as eye irritation) to death. Hydrogen sulfide exposure often claims more than one victim, since unprotected individuals attempt to rescue fallen co-workers, friends, or relatives, and subsequently die themselves.

In this course, the participant will learn the hazards of hydrogen sulfide, detection and exposure reduction methods, and appropriate responses in an emergency involving hydrogen sulfide.

Improving Productivity

Mastering productivity skills will make employees more valuable, and their work more satisfying. This course teaches basic skills for setting goals, prioritizing tasks, and managing time. Participants will learn to target the most important work first, avoid time-wasters, delegate appropriately, and make efficient decisions.

Infection Prevention and Control

In the United States, there are an estimated 8.8 million persons who work in healthcare professions. Healthcare workers may acquire infections from patients or other personnel, household members, or other community contacts, and transmit infections to them as well. Studies indicate that well-organized infection control programs can prevent one-third of infections acquired at healthcare facilities, yet only 6-9% are actually prevented because specific safe work practices are not followed.

This course presents information about how infections are transmitted and methods for infection control.

Internal Environmental Audits

Many companies are fearful that results from internal audits may be used against them by the EPA, resulting in fines, money damages, and adverse publicity. However, a recent EPA policy statement on “Incentives for Self-Policing” grants substantial reductions in penalties when companies manage their own compliance responsibilities, and exercise due diligence in detecting and preventing EPA violations. Companies who do not use this opportunity face fines in criminal and civil cases for tens of millions of dollars, as evinced by recent court cases.

After completing this course, the participant should understand the purpose and the elements of an effective internal environmental audit.

Introduction to Information Systems

In the modern age, work is increasingly being accomplished through use of computer-based information systems. Generally, the better an organization’s information systems, the more successful the organization. In this course, participants will learn about the different types of information systems, and how they can enhance organizational and personal performance.

Introduction to Workplace Safety

Millions of injuries and illnesses occur in the workplace each year, and thousands of workers die as a result of on-the-job incidents. This course provides a safety orientation, and sets the basic knowledge foundation for all other safety programs and training courses.

The content of this course includes common workplace hazards, accident prevention, and employee involvement. At the end of the course, participants are expected to be able to recognize potential safety hazards, and either correct them, or notify management.

Investigating Employee Claims

Investigations into employee claims or misconduct are growing in all areas of corporations, government, armed services, churches and schools. Unfortunately, managers and supervisors rarely have the background or experience to investigate employee claims or misconduct. This inexperience often results in inconsistent or haphazard investigations, which can be dangerous for any company.

This course presents information about how to implement thorough and consistent investigations with specific pointers regarding common problems such as sexual harassment and discrimination.

Ladder Safety

There are more than 24,000 ladder-related injuries in the U.S. every year, most resulting from improper use and maintenance of ladder equipment. This course teaches participants about the various ladder types, selection of the right ladder, ladder inspection and setup, and safe ladder usage.

Lead

Potential exposure to lead, with known toxic effects, occurs in at least 120 occupations. This course will teach participants the exposure limits, and health hazards associated with this toxin. Participants in this course will learn how to monitor lead levels and how to use protective equipment when working with lead, as well as medical surveillance procedures and details of the lead standard.

Lockout/Tagout Affected

Many injuries in the workplace occur during maintenance and repair of hazardous machinery. A majority of these injuries can be prevented if the energy sources are isolated, locked, and tagged out prior to maintenance or repair. This course teaches participants the hazards of locked out/tagged out equipment, roles and responsibilities of affected versus authorized employees, and rules for recognizing a lockout/tagout procedure

Lockout/Tagout Authorized

Many injuries in the workplace occur during maintenance and repair of hazardous machinery. A majority of these injuries can be prevented if the energy sources are isolated, locked, and tagged out prior to maintenance or repair. This course teaches participants the hazards of locked out/tagged out equipment, roles and responsibilities of authorized versus affected employees, proper energy control methods, and steps for completing a lockout/tagout procedure.

Machine Guarding

Thousands of workers suffer serious injury, such as crushed hands and arms, severed fingers, and blindness every year due to missing or improperly installed machine guards. These injuries can be prevented if proper safety precautions are in place. This course presents an overview of machine safeguarding requirements and techniques in the industrial setting. Participants will also learn some common guarding solutions.

Making Meetings Work I: Purpose and Preparation

Employees in today’s companies invest significant amounts of time and effort into meetings. Unfortunately, this use of group decision-making is often cumbersome, inefficient, and sometimes even downright chaotic. Rather than feeling a sense of satisfaction, participants often express frustration with the process.

This course teaches ways to assess the effectiveness of meetings, and skills to enhance the meeting process. Whether you lead or participate in the meeting, these preparation skills will make for better, more efficient meetings.

Making Meetings Work II: Leadership

The success of any meeting is largely determined by the leadership skills of the key participants. In many cases, more than one person fulfills leadership functions at various times in the meeting. These functions include setting the tone and meeting climate, clarifying the purpose, initiating discussion, assuring that the process stays on track, and systematically moving the group toward a satisfactory conclusion.

Managing Conflict

As work force numbers shrink, and individuals are called to interact more intensely with fewer people, the ability to manage conflict effectively becomes more important. This involves both a certain sensitivity and an ability that blurs the line between work skills and life skills.

Participants in this course will learn how to recognize appropriate responses to conflict, based on time and importance constraints. They will learn to confront conflict, while still respecting the viewpoints of others, ultimately leading toward collaborative resolutions when such are appropriate.

Managing Job Stress

Stress is a major factor in employee attendance, work performance, and EEOC claims. This course provides participants with an opportunity to assess their stress level at work, and learn strategies for coping with that stress. Participants will also learn techniques for dealing with difficult people, as well as problems on the job.

Managing Transition to Teams

This course will help team leaders and team members to understand the process of moving from a hierarchical structure and mindset to a more team-oriented approach. Participants will learn about the role of Vision, Coaching, and The Line between management responsibility and team responsibility in the transformation from hierarchy to team.

Office Safety

Office environments do not usually appear hazardous. And though the human body is quite remarkable, it is not a machine, and is not prepared for some tasks such as lifting heavy objects, or spending many hours in front of a computer. Office workers can suffer anything from sprains or strains to fatigue, stress, or problems stemming from lack of exercise.

The participant in this course will learn safety information, and ways to protect against the hazards found in the office environment. These hazards include slips, trips and falls, as well as strains, sprains, and general office hazards.

Personal Leadership Power

Personal Leadership Power (PLP) is the inner resolve that propels people to great achievements. Increasing your PLP will make you a more effective employee, a better citizen, and a better person. This course presents information about what leadership is, how to increase your PLP, and how to apply PLP to increase the productivity of your company.

Personal Protective Equipment

Personal protective equipment (PPE) includes some of the items most frequently used to protect workers from hazards. In this course, participants will learn the general and specific requirements for various types of PPE, such as eye and face protection, and methods for properly storing and maintaining PPE.

PPE Assessment

Thousands of workers suffer injuries each year. In many cases, these injuries could have been prevented by wearing appropriate personal protective equipment (PPE). Employers are required to assess the workplace and identify hazards which require the use of PPE, and to communicate this information to their employees, as well as provide them with the necessary protective equipment.

In this course, the participant will learn how to perform a workplace hazard assessment for PPE which covers what hazards to look for, how to collect and organize assessment data, how to estimate the level of hazard risk, and how to select PPE for employees properly.

Process Gauge Radiation

Process gauges are found in chemical plants, refineries, and steel mills, and are one of many sources of industrial radiation. Process gauges measure the density of liquids, solids, levels within a vessel, and the thickness of solid materials. While they serve a useful function, their radioactive sources present a potential health hazard if not handled properly.

Participants in this course will learn the uses of process gauges, along with the risks and safety regulations associated with process gauges.

Process Safety Management: Contractors

An estimated one-third of routine maintenance, and one-half of turnaround maintenance work in process operations is performed by contract labor. To ensure that contractors are well-informed about process safety practices, they must understand the potential work environment hazards and observe the same safety rules, regulations, and standards as permanent workers.

This course presents information about what employers and contractors must do to ensure the health and safety of contractors.

Process Safety Management: Incident Investigation

The Process Safety Management (PSM) program is designed to identify risks associated with highly hazardous chemicals and to provide information so that proper actions can be taken to minimize the probability of a release. However, even proactive steps cannot completely eliminate the risk of undesirable events. When these events occur, they must be thoroughly investigated to provide information for future prevention. In fact, proper incident investigation is one of the most powerful tools to reduce the number of incidents in the workplace.

This course presents general information about incident investigations, and describes the four key activities that result in an effective investigation.

Process Safety Management: Management of Change

The prime role of employees is to change things — to operate, to transport, to repair, to fix, and so on. While change is good, studies show that when industrial processes change, the risk of injury increases. Managed change can reduce this risk, while unmanaged change can produce disastrous results.

The participant in this course will learn the definition and purpose of Management of Change, as well as what is covered under MOC. The participant will also learn employer and employee responsibilities for implementing MOC, and the key components to consider in developing MOC procedures.

Process Safety Management: Mechanical Integrity

Catastrophic events in chemical process operations often result from inadequate mechanical integrity caused by unsafe conditions and human error. These two factors can be deadly. A process facility can greatly reduce its risk of catastrophic events, and the resulting loss of life and property, by including a Mechanical Integrity program within its overall Process Safety Management (PSM) program.

This course presents information about the purpose, key elements, and implementation steps for developing a Mechanical Integrity program.

Process Safety Management: Operating Procedures

A wide range of operations in industrial process plants must work together for safe and efficient performance. Procedures for these critical operations must be established and followed properly to avoid disasters which can result from human and mechanical error. Employees in the process industry must be keenly aware of operating procedures for process efficiency, increased safety, environmental protection, higher production levels, and consistent product development. They must follow these operating procedures properly.

In this course, participants will learn when and how operating procedures are developed, what is contained in them, and the importance of following them in process operations.

Process Safety Management: Overview

Unexpected releases of toxic, reactive, and flammable liquids and gases have caused many disasters in recent years. These and other disasters involving highly hazardous chemicals resulted in a need for increased industry controls.

The participant in this course will learn what PSM is, and who it covers. The participant will also learn the components of PSM, and the importance of employee involvement.

Process Safety Management: Pre-Startup Safety Review

This course presents information about industrial process startups and associated problems, pre-startup safety reviews (their purpose and implementation), and pre-startup safety review teams.

This course covers how to participate in a pre-startup safety review, with an understanding of its purpose, and an expectation of what will occur and who will be involved.

Process Safety Management: Process Hazard Analysis

Process hazard analysis (PHA) is a method used to identify where hazards exist, how the process design responds to upsets, and what additional measures could be taken to prevent or minimize catastrophic releases of chemicals.

During this course the participant will learn to identify the need for a process hazard analysis, as well as various methods and steps of performing the analysis.

Process Safety Management: Process Safety Information

In order to understand the hazards associated with a chemical process, documentation relating to the process must be gathered. This data provides the basis for developing process hazard analyses, preparing operating and maintenance procedures, training, performing incident investigations, and managing changes as they occur.

In this course, the participant will learn what process safety information is, the three main process safety information categories, and what specific data is gathered within these categories.

Process Safety Management: Training

Inadequate employee training results in accidents. It is estimated that only 30% of employees are trained to recognize and protect themselves from the hazards in their workplace. Well-trained employees are the most valuable asset for any organization. A company is only as productive and safe as its employees are.

This is especially true today with new industrial systems and equipment being introduced to the workplace daily. Employees must be adequately trained to perform productively AND safely with new technologies which use higher pressures, extreme temperatures and new chemicals.

This course presents information on the nature and components of a well-designed Process Safety Management (PSM) training program as it relates to facilities dealing with highly hazardous substances.

Quality Management Refresher

All firms must understand how to deliver products and services of high quality in order to remain competitive. In the end, quality management is not about buzzwords and labels, it is about performance, competitiveness, and customer satisfaction. This course presents refresher information about the fundamental ideas, principles, and tools of quality management. It assumes that basic quality practices are already in place, and is designed to help keep firms on track in their quality management practices.

Respiratory Protection

A lack of oxygen, or contamination of air from hazardous particulates, gases, or vapors poses a threat to the human respiratory system. Many lives are saved each year because employees have been trained to use respiratory protection equipment properly.

This course teaches participants the types of respiratory hazards in the workplace, and the effects on the respiratory system, as well as how to select, use, maintain, and store respiratory protection equipment.

RMP: Accident History

Understanding why catastrophic releases of hazardous substances occur is critical to preventing similar accidents from recurring. For this reason, companies who must comply with EPA's Risk Management Program (RMP) rule must compile a five-year accident history of on-site and off-site impacts caused by such releases.

This course presents information about the accidents that must be compiled, analyzed, and submitted to the EPA as a part of an overall RMPlan.

RMP: Determining Applicability

Industrial accidents release hazardous substances into the environment, exposing the public, as well as natural resources, to the harmful effects of these substances. The Environmental Protection Agency (EPA) has developed a regulation which will be implemented by approximately 66,000 facilities around the United States, and offer the public and the environment protection. This regulation is called the Risk Management Program (RMP) rule.

This course presents information about the types of facilities that are subject to the rule, and how to determine if a facility is covered.

RMP: Determining RMP Program Level

The purpose of the Environmental Protection Agency's Risk Management Program (RMP) rule is to prevent as well as control potential releases of hazardous substances from chemical processes within a facility. In order to address the different hazards associated with various types of chemical processes, the EPA requires companies to comply with the RMP rule at one of three Program Levels. Under this system, companies with higher hazard processes must perform more risk control activities compared to those with lower hazard processes.

This course presents information about the Program Levels used by the EPA to classify chemical processes and what companies must do to comply with each Level.

RMP: Implementation and Communication

The EPA's Risk Management Program (RMP) regulation is aimed at preventing accidental releases of hazardous chemicals that pose risks to the public and the environment. The RMP regulation is a performance-based rule, and does not contain any mandatory prescription that outlines steps a facility can take to achieve compliance. Accordingly, covered facilities must develop a comprehensive site-specific RMP implementation and communication plan to perform various required tasks.

This course outlines the importance of such plans, and identifies some key tasks that must be included in RMP efforts.

RMP: Introduction

Public awareness of the potential danger from accidental releases of hazardous chemicals has increased over the years, due to serious releases which have occurred worldwide. These disasters suggest the need for enhanced risk management regulatory controls to eliminate or minimize potential dangers in the future. The Environmental Protection Agency's Risk Management Program (RMP) rule was created to prevent serious chemical releases that could affect public health and the environment, and to improve the response to any accidents that do occur.

This course introduces the Risk Management Program (RMP) series designed to support RMP rule compliance.

RMP: Management Systems

During a recent five-year period, nearly 35,000 accidents involving toxic chemicals occurred in the United States. 2,070 of these resulted in immediate death, injury, or evacuation. That is why the Environmental Protection Agency's Risk Management Program (RMP) rule was created. It is required for companies who have operations dealing with complex chemical processes, and is intended to save both human lives as well as the environment.

To implement the RMP rule, companies that qualify for Program Levels 2 and 3 must develop a Management System. This course introduces the RMP Management System requirements.

RMP: Prevention and Emergency Response Programs

The Environmental Protection Agency (EPA) Risk Management Program (RMP) rule requires that facilities handling certain regulated chemicals develop detailed prevention programs for minimizing accidental risks. These facilities must also coordinate emergency response programs for controlling accidents when they occur. This course explains what a company must do to comply with the prevention program and emergency response program requirements of the RMP rule. Participants should be familiar with the PSM regulation, process terminology, and know what RMP Program Level processes apply to their facility.

RMP: Risk Management Plan Submission

Increased communication between chemical facilities, the public, and the government helps to decrease the hazards associated with hazardous chemical releases. As part of the Risk Management Program rule requirements, the EPA requires that covered facilities submit a Risk Management Plan (RMPlan), which helps increase this communication. This plan provides chemical hazard information, which is submitted to the EPA, and then placed on the Internet for public access.

This course describes what an RMPlan is, and how it is made available to the public. Participants should have an understanding of the RMP rule and how it applies to their company. It is recommended that they be familiar with the concepts of off-site consequence analysis, accident histories, prevention, and emergency response programs.

Safety Signs and Color Codes

We see signs and color coding everywhere in our daily lives. It is used in the workplace to warn us of danger, inform us where to use caution, and instruct us on safe work practices. In this course, the participants will learn about environmental control safety signs and tags, including those for different hazards and slow moving vehicles. They will also be shown examples of how signs and color codes are used in typical workplace situations.

Scaffold Safety

Falls are the leading cause of traumatic death in construction, and many of these falls are related to scaffolding. Though most scaffold accidents are due to falls, each year many workers are also injured or killed in scaffolding incidents involving falling objects and electrocution. During the period between October 1997 and September 1998 in the United States, scaffolding violations were the most frequently cited violations by OSHA. In fact, 6,637 scaffolding violations were cited during 2,678 workplace inspections, resulting in total fines of $6,315,370.50.

This course presents information about the hazards of working with scaffolds and procedures for controlling or minimizing the hazards of scaffold use.

Self-Motivation

Successful people are good at self-motivation. They don’t need external rewards or social approval to pursue the things that are important to them. Participants in this course will learn the five characteristics of self-motivated people, and the five skills that are necessary to develop these characteristics.

They will learn how to apply these skills at work, at home, and in the community.

Self-Problem Solving

This course is designed to help employees understand how to solve problems and resolve personal conflicts in the work environment. Participants in this course learn that their perception of a problem is the problem, and that how they respond to that problem is the key to problem solving in any work situation. They also learn how to create win-win scenarios for common work-related situations.

Sexual Harassment Awareness for Employees

Sexual harassment is a complicated issue, which can be very personal. In this course, participants are given clear definitions and examples of sexual harassment, along with guidelines for avoiding harassment situations in the workplace, and dealing with them if they do occur.

Sexual Harassment Awareness for Managers

Sexual harassment is perhaps the most complicated and sensitive issue faced by managers and supervisors in today's work environment. Recent Supreme Court decisions have changed the sexual harassment landscape and created clear liability for employers in this area of employment relations.

This course presents an overview of sexual harassment, with an emphasis on the specific responsibilities of managers and supervisors to prevent all types of harassment. This course aims to reduce the potential liability for employers in this area. Given the importance of investigating sexual harassment claims, it is highly recommended that this course be taken in conjunction with the "Employee Investigations" course. In addition, it might be helpful to review the basic "Sexual Harassment" course for employees.

Slips, Trips, and Falls

There are about 350,000 injuries related to slips, trips, and falls each year and they account for 10% of workplace deaths.

This course teaches participants how to recognize physical hazards, and the human actions that cause these types of accidents. In addition, participants will learn methods of prevention, and general requirements for walking and working surfaces.

SMART Goal Setting

Goals that adhere to Specific, Measurable, Attainable, Results-Oriented, and Time-Bounded (SMART) criteria are more likely to lead to completion of tasks, and higher satisfaction. This course will help participants understand the impact of goal setting on their lives, and give them a road map they can use to achieve higher personal and professional productivity.

Substance Abuse

Substance abuse is one of the fastest growing problems in the workplace. In this course, participants will learn how to deal with substance abuse issues both at the workplace and in the home. Participants will learn about the psychological and physical effects of substance abuse, and common behavior characteristics exhibited by co-workers and family members with abuse problems.

Tool Safety

Thousands of workers are injured every year due to improper use of hand and portable power tools. These injuries can be prevented if proper tool use is followed. This course presents the most common tool hazards, safe selection and use of tools, tool inspections and modifications, and the proper storage and maintenance of tools.

Toxic Substance Control Act (TSCA) Reporting

Approximately 75,000 chemical substances are used in American commerce today. While many substances pose health or environmental risks, some toxic substances pose particularly unreasonable risks, and therefore must be tracked and regulated by the Environmental Protection Agency (EPA). This course presents information about how companies and employees must work together to report information about these chemical substances to the EPA.

Tuberculosis: Exposure Prevention and Control

TB kills almost 3 million people a year. It is the leading cause of death from an infectious agent in the world. In recent years, a number of outbreaks of this disease have occurred in hospitals, correctional institutions, homeless shelters, nursing homes, and residential care facilities for AIDS patients. Nationwide, at least several hundred people have become infected, and have required medical treatment after workplace exposure to TB.

This course presents the basics of how TB infects and spreads, how to recognize signs and symptoms of TB, and how to protect yourself around known or suspected TB patients.

Violence in the Workplace

Threats, intimidation, and fear create a hostile work environment. This course creates an awareness and understanding of violence in the workplace. Participants will learn how to identify individuals prone to violent behavior, and apply proven techniques to diffuse dangerous situations.

Walk-Behind Forklifts

Walk-behind forklifts are used as an efficient and economical way of moving materials. While they have many benefits, these vehicles can be deadly when operated incorrectly. To avoid these injuries, it is important to know how to operate a walk-behind forklift safely, and how to avoid dangers in the work area.

This course presents information about how and when walk-behind forklifts are used, how to determine whether a walk-behind forklift is safe to operate, safe operating procedures, and inspection requirements.

Welcome to KnowledgeWire® Enterprise Solutions

This short course helps new participants get acquainted with some of the features of KnowledgeWire® Direct, so that they get the most from their time online.

Participants in this course will learn the basic components of the KnowledgeWire(R) learning environment, as well as how to take a course. New subscribers are automatically registered for this course.

Welding Safety

More than a half million U.S. workers each year are at risk for blindness, scarring burns, partial and permanent disabilities — and even death, due to the hazards of welding, cutting and brazing. Fatal welding-related incidents most likely will involve explosions, electrocutions, asphyxiation, falls, and crushing injuries. The risk from these fatal injuries alone is more than four deaths for each thousand welders and helpers over a working lifetime.

This course presents specific physical and health hazards associated with welding, how to select and use proper personal protective equipment for specific hot work assignments, and basic welding safety procedures.

Workers' Compensation — Texas

In 1989, the Texas Legislature found much inefficiency in the way work-related injuries was handled in Texas. In addition, the fatality rate in Texas was one of the highest in the nation, while benefit rates were among the lowest. As a result, the Texas Workers' Compensation Act was amended to address these issues. This course presents information about what workers' compensation benefits are, the rights and responsibilities workers have if they are injured, and the procedures injured workers should follow when they are injured on the job.

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CII Use of Technology-Assisted Learning

Plenary Slides

Change Orders and Their Cumulative Impact

Cumulative Change Order Impacts Research Team

Learning Objectives

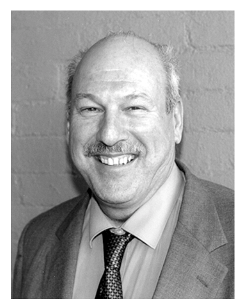
- Discover what cumulative impact is and understand how we know it is real.
- Learn how to track labor productivity right from the beginning of the project, and how to be pro-active rather than waiting until the end to determine the extent of the damage.
- Find out how to determine if a project has been impacted, and if so to what extent.
- See why there is a strong correlation between the amount of change orders and the loss of productivity.
- Obtain some best practices and specific recommendations for owners and contractors on how to use the tools proactively.

Abstract

This presentation will expose the impact of cumulative change orders on project execution. Find out about new tools to analyze the impact on your project.

Plenary Session Presenter

Richard L. Camlic – Engineering Process Manager, Sheet Finishing & Utilities, U.S. Steel



Rich Camlic is Engineering Process Manager, Sheet Finishing & Utilities, for the U.S. Steel Fairfield Works in Fairfield, Alabama. He has been with U.S. Steel since 1963 and has served in a variety of positions during the past 37 years with the company. Among his assignments, he has taught the electronic apprenticeship course and held various line management positions. He also has served as area manager, general foreman, senior design engineer, senior process engineer, senior project engineer, and process manager. He currently chairs the Cumulative Change Order Impacts Research Team for CII. Rich holds electrical engineering and MBA degrees from the Illinois Institute of Technology.

Implementation Session Moderator

Hanford Gross – President, Gross Mechanical Contractors

Hanford Gross is President of Gross Mechanical Contractors in St. Louis. He has been with the firm for the past 15 years, serving in various capacities. His experience includes project engineer, project manager, manager of the construction department, and his current position as president. He has been a member of the CII Cumulative Impact of Change Orders Research Team since it was formed in 1997. Hanford is a licensed professional engineer and is a mechanical engineering graduate of Washington University, St. Louis, Missouri.

Implementation Session Participants

Richard L. Camlic, Engineering Process Manager – U.S. Steel

George B. Armenio, Advanced Construction Estimator – General Motors Corporation

Awad S. Hanna, Professor, Civil & Environmental Engineering – University of Wisconsin

Kevin P. Hughes, Project Manager – FPL Energy, Inc.

Wayne Montgomery, Vice President, Project Management – Kvaerner Process

Change Orders and Their Cumulative Impact

Cumulative Change Order Impacts Research Team

Executive Summary

Change is inevitable on construction projects, primarily because of the uniqueness of each project and the limited resources of time and money that can be spent on planning, executing, and delivering the project. Change clauses, which authorize the owner to alter work performed by the contractor, are included in most construction contracts and provide a mechanism for equitable adjustment to the contract price and duration. Even so, owners and contractors do not always agree on the adjusted contract price or the time it will take to incorporate the change. What is needed is a method to quantify the impact that the adjustments required by the change will have on the changed and unchanged work.

Owners and our legal system recognize that contractors have a right to an adjustment in contract price for owner changes, including the cost associated with materials, labor, lost profit, and increased overhead due to changes. The actions of a contractor likewise can have an impact on a project just as easily. A more complex issue is that of determining the cumulative impact that single or multiple change orders may have over the life of a project.

The Construction Industry Institute (CII) took on this issue by forming the Cumulative Change Order Impact Research Team. The research team was tasked with investigating the cumulative impact of change orders on electrical and mechanical efficiency.

This research resulted in the development of two models, one to identify if a construction project has been or is likely to be impacted as a result of cumulative change, and the other to predict the magnitude of the cumulative impact due to project change. Like most models, the resulting answer is not “THE ANSWER” but rather, a most likely answer that fits within a range of possible answers depending on a “confidence factor.” To feel comfortable with the results the user expects a confidence factor of 80% or higher, ours meets this comfort factor.

Changes occur on a project for a variety of reasons. In addition, a ripple effect may be felt throughout the project due to a single change or to multiple changes. Generally, contractors are required to price the change order before the work is done, yet schedules often do not allow time to develop a comprehensive impact assessment to incorporate the ripple effect to the project. Contractors often are ordered to proceed with additional work while agreement on the cost of the change order or the extent of the impact remains unresolved.

The research by CII has determined a strong correlation between the amount of changes on a project and loss of productivity. The research team has developed a model capable of predicting the amount of impact caused by changes in the mechanical and electrical areas of a project. A summary of the research follows, including recommendations for both owners and contractors on the approaches each party could take that would increase the effectiveness of the overall project while focusing on the common goal of project success.

Introduction

Background

The Project began with an extensive review of previous literature pertaining to the effect of change orders on projects. Not unexpectedly they all concur that change is inevitable on most construction projects due to the uniqueness of each project and the limited resources of time and money that are available for planning, executing and delivering the project.

Problem Statement

Many courts and administrative boards recognize that there is cumulative impact above and beyond the change itself, however, current construction contracts do not typically include adequate language that enables fair and equitable compensation for the unforeseen impact of cumulative change. Often, the contractor fails to foresee, and the owner fails to acknowledge, the “synergistic effect” of the changes on the work as a whole when pricing individual changes, and thereby receives less than full compensation. Consequently, projects that exceed cost or schedule targets are likely to lead to claims. Determining the impacts that changes can have on contract price and time can be arduous, due to the interconnected nature of the construction work and the difficulty in isolating factors to quantify them. As a result, it is very difficult for owners and contractors to agree on equitable adjustments, especially for cumulative impact.

Research Objectives

The purpose of this research project was to quantify the cumulative impact of change orders on labor efficiency. The team set out to attain the following four objectives:

1) Investigate how change orders impact labor efficiency over the entire project.
2) Determine and isolate specific measurable characteristics of projects that are impacted by cumulative change.
3) Develop a definition and model of cumulative change impact that can be used by owners and contractors to identify when it has or, if it will occur.
4) Develop a method to predict the magnitude of cumulative impact due to project change.

Delta Approach

In order to study the productivity loss associated with change orders, a standard method to calculate the productivity for a project is needed. The method needs to represent the cumulative impact of change including any ripple effects. To do this the researchers have defined the term Delta, which is shown graphically in Figure 1 as the difference between the actual labor hours expended to complete the project and the estimated base hours (including the approved change order hours).

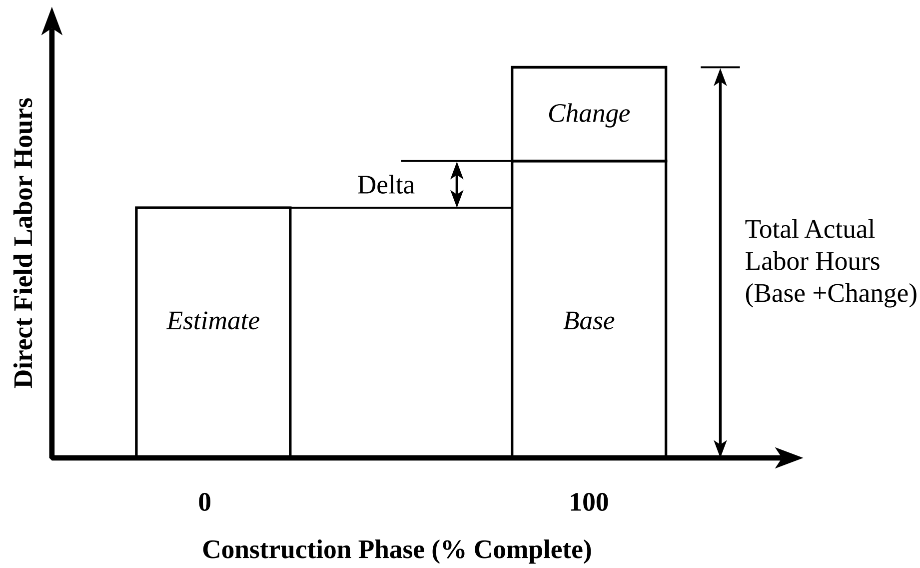


Figure 1. Definition of Delta

Positive values of delta indicate that the actual productivity is less than the planned or estimated productivity. Negative values of delta are an indication of higher efficiency than originally planned or estimated. Delta can be attributed to a contractors incorrect estimate, a contractors inefficiency or the impact of productivity related factors, such as change orders, weather conditions, work interruptions and rework among other factors. In order to study the impact of change, the research team solicited projects where change orders were thought to be the main reason for loss of efficiency and not other factors such as inaccurate estimates or weather. The Delta then represents the effect of the change orders on the project. This data was reviewed by the academics and confirmed to be the case.

Percent Delta

To be able to compare projects of varying size, it is necessary to scale Delta by the project size, which yields the term Percent Delta (%DELTA). %DELTA is defined in equation 1.1 as Delta divided by the actual work-hours utilized to complete the project.

The formal mathematical definition of %DELTA is as follows:

$$\%DELTA = \frac{(\text{Total Act. Direct Labor Hrs.}) - (\text{Est. Hrs.} + \text{Approved Change Order Hrs.})}{\text{Total Act. Direct Labor Hrs.}} \text{ X } 100$$

The Delta approach allows for a macro analysis that accounts for the full ripple effect that change orders have on the entire project.

Methodology

The first task of the team was to develop a comprehensive questionnaire that would provide data on factors that the team felt could, based on experience, influence change orders during execution of a construction project. The research team consisted of three representatives each from the Electrical Contracting Foundation, Mechanical Contracting Foundation and six from the Construction Industry Institute. The research team then set out to conduct a pilot study to determine how easily the questionnaire could be answered and if the data collected would be useful in achieving the research objectives. After reviewing the data and talking to the participating contractors, the final questionnaire was developed.

The first section of the questionnaire contained general background questions about the contractor. The other two sections were for an “on budget” project and an “over budget” project. The contractors were requested to submit projects that were perceived to be over budget as a result of change orders, and not factors such as low estimates, unforeseen weather conditions, or poor field planning. The projects were investigated based purely on work-hours and not by cost (dollars). Unlike other studies, we chose work-hours as our base unit, instead of dollars, because work-hours are directly comparable. Dollars add complexity for a number of reasons, among them pay scale, premium time differentials and material costs. In addition to the questionnaire, actual and estimated manpower-loading charts or weekly labor hours were requested for each project along with the change order log, if available.

Recommendations and Conclusions

Summary

Because change orders occur on virtually every construction project, how you manage them can make or break a project, especially in labor-intensive fields such as mechanical and electrical construction. This research was undertaken to provide a quantitative method for both owners and contractors to determine if change has impacted a project, and also to provide a model for determining the magnitude of impact.

A previous study on the effect of change orders was conducted by Charles Leonard. This is still a highly respected study, however his data set was not selected randomly, but from extreme cases that went to the claims stage and as a result, does not represent the general population. This somewhat limits the applicability of the results. Furthermore, no effort was made to separate mechanical projects from electrical projects or to investigate these differences. Our study is based on a random sample of both impacted and unimpacted projects which provide the basis to develop a model to determine the differences between the characteristics of each type of project. We observed subtle differences between mechanical and electrical projects and subsequently created a separate data base for each. The data from each was then used to develop a model capable of confidently predicting the amount of impact for each type of project.

Chapter one presented background information on the construction industry as a whole as well as the mechanical and electrical construction industries. The problem statement, research objectives, and research scope were all discussed, as well as definitions, assumptions, and the methodology for the current research process.

Chapter two described the evolution of the cumulative impact principle and to what extent the Board of Contract Appeals and the Courts influenced the procedures required for Owners and Contractors to prevail in their efforts to prove or disprove the reality of cumulative impact. The factors that affect change orders were used as the basis for a questionnaire and sent to a multitude of contractors to create a database from which a model could be developed.

Chapter three discussed the use of Logistic Regression analysis to develop the Impact Model. The tool (Model) for determining if a project has been impacted was developed and an example of how to use it was presented. This tool determines if a project has been impacted with a confidence factor of greater than 80%.

Chapter four developed the tool (Model) that allows Owners and Contractors to predict the magnitude of impact resulting from the cumulative effect of change orders. Of the 42 impacted projects that were predicted using this model, all 42 were predicted within ± 24% of the actual %DELTA, 39 of the 42 were predicted within ± 15% of the actual %DELTA, 33 of the 42 were predicted within ± 10% of the actual %DELTA and the remaining 18 of the 42 projects were predicted within ± 5% of the actual %DELTA. An example of how to apply the model was presented.

Helpful Practices for Project Stakeholders

It became apparent as the models were being developed that certain practices, if followed, were more likely to keep a project from being impacted, or would at least indicate that a negative trend was starting. A few of these Helpful Practices are listed below for both Owners and Contractors.

Recommendations to Owners

Owners have a significant amount of control over the outcome of a project. Many of the decisions they make early in the project will have impacts on the rest of the project.

Pre-Project Planning

The most common reasons for change orders are additions, design changes, and design errors. By spending more money on the design up front, the owner could decrease the number of change orders associated with design problems, increase the percent of the design complete prior to the award of the contract, and increase the degree of coordination in the designs between the different trades. These are all factors that were found to be significant in this study.

Change Order Processing Time

The time between the initiation of the change order and the owner's approval should be kept as short as possible. By decreasing the processing time of change orders, the project is more likely to be unimpacted and to see a smaller productivity loss associated with the change orders. There is a strong correlation between the processing time and the percent of the change order hours that are approved by the owner (P-value = 0.002).

Manpower Data

The research team strongly recommends that owners require contractors to present a manpower loading curve as a part of their proposal. When the actual work-hours are updated on a regular basis and compared to the planned manpower curve as the project progresses, it provides an early warning signal that labor productivity has changed. It could be an indication that labor efficiency has decreased (more actual work-hours used than planned), or it may also indicate that the contractor is performing more efficiently than planned (less actual work-hours used than planned). More information on manpower loading charts and S-curves can be found in Appendix A.

Recommendations to Contractors

Actions of a contractor can impact a project just as easily as those of an owner. It should come as no surprise that some of the recommendations are uniform for owners and contractors alike. This should be the case considering that everyone on a construction project should be working toward the same goal.

Contractor Management Tools

Two of the most important tools of a contractor are the schedule and the manpower loading curve. As with the Owner, these tools allow the Contractor to track the progress of the project as well as many other factors such as the ratios of Actual Peak over Actual Average Manpower and Estimated Peak over Actual Peak Manpower (more on this in Appendix A). They also provide a means for defending a claim after the completion of the project should a disagreement arise.

Whether the contractor tracked and updated the schedule during construction showed up as a significant factor in hypothesis testing as well as in many of the preliminary models developed to quantify the productivity loss. Projects where the schedule was updated regularly had lower productivity losses.

Recommendations for Future Research

This study has made another step towards understanding the cumulative effects of change orders on labor productivity in the construction industry. In order to understand fully these effects though, further research is needed. The following recommendations for future research would benefit the construction industry:

Scope of Research

The current research was limited to mechanical and electrical construction, and design-bid-build projects with lump sum contracts. There is a trend in the construction industry to use the design-build or EPC delivery systems more and more. The scope of this research needs to be expanded to include other construction disciplines, other project delivery types, and other contract types.

Manpower Loading Relationships

Manpower loading curves have proven to be extremely beneficial tools for contractors as well as owners. Unfortunately, few contractors utilize this tool for project analysis. Consequently, data regarding this material are difficult to obtain. If more data were available, the relationships between project size and duration, project size and peak manpower, project size and average manpower, and average manpower and peak manpower could be expanded to include numerous building and construction types. The manpower loading curve analysis and S-curve analysis also could be further refined to develop another quantitative measure for determining whether a project has been impacted or not.

Conclusions

We have determined that there is a strong correlation between the amount of change items initiated on a project and the loss of productivity (%DELTA). As the number of change items increase you are more likely to have an impacted project. Two models (equations) were developed. While we have confidence in the developed models, the team would like to reiterate that it is best to use the results in conjunction with hard data developed from the project, for example manpower loading curves and productivity tracking data. It is further suggested that both Owner and Contractor track estimated manpower loading curves (see Appendix A) against actual work-hours as the project progresses. This will allow pro-active steps to be taken to correct negative trends rather than waiting for the end of the project to determine to what extent they affected the project. We also recommend that the owner and contractor agree to utilize the developed models for change order conflict resolution prior to signing the contract. It would minimally provide a starting point for negotiations.

The goal of this study was to quantify the cumulative effects of change orders on labor efficiency. The study was undertaken to make use of industry-aggregated data to substantiate the impacts of change on project-level labor efficiency. These goals were met through the presentation of industry trends along with logistic and linear regression models for determining and quantifying impact. It is expected that these models will assist individuals industry-wide in their understanding of how change orders affect labor efficiency.

Implementation Sample Project

In addition to the interference of the 4" conduit there where many other change orders approved on this project. After reviewing the final paper work on the design-bid-build lump sum project for Acme Fabricators, Kevin Hughes, Pandor Mechanicals project manager, was wondering if he had spent all of his time managing the project instead of 75% of his time, if the project would have gone any smoother. In retrospect, he thought if he had spent more time looking at the data provided by the productivity tracking software he might have been able to take some pro-active steps to reduce the over run. Now he had to go to the Owners office with the projects final paper work in hand and try to recoup the extra cost of the project that he felt was a result of the cumulative impact of change orders. When Kevin met with the owner, he proceeded to explain that while the original estimate to complete the project was 12,500 work-hours, the actual work-hours needed to complete the project was 22,000 work-hours. This included the 5,625 work-hours of approved change orders, with a total of 40 change items. Thirty six (36) of these change items were owner initiated (90%). Design changes and errors accounted for 4,780 work-hours (85%). The owner responded by reminding Kevin that the average processing time of change orders took 6 days, much better than their past history. Because of the fast track schedule, Pandor Mechanical was forced to utilize overtime as well as overman the crews to meet the start date. The overmanning resulted in Pandor exceeding their estimated peak manpower of 27 people by 185% (50 people) and increased their actual average manpower to 30 people.

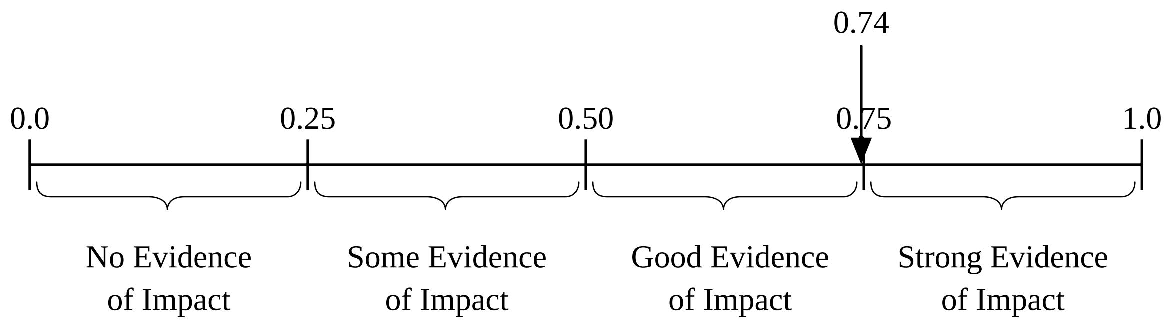
To determine if our project was impacted we insert the proper data from our project into the table developed by our research team below.

Factor (1)	Value (2)	Coefficient (3)	Product (4)
1. Constant	1	-6.997	-7.00
2. Mechanical or Electrical 1 if mechanical, 0 if electrical	1	-1.0939	-1.09
3. Percent Change X (Mech_or_Elec) Percent change hours versus estimated project hours as a decimal multiplied by 1 or 0	0.45	3.889	1.75
4. Estimated/Actual Peak Manpower Estimated Peak Manpower = 27 Actual Peak Manpower = 50 Estimated/Actual Peak Manpower = 0.54	0.54	-1.0371	-0.56
5. Processing Time Average period of time between initiation of the change order and the owner's approval. 1 = 1–7 days 2 = 8–14 days 3 = 15–21 days 4 = 22–28 days 5 = Greater than 28 days	1	0.6342	0.63
6. Overmanning (Est. Peak/Actual Peak Manpower)= <0.77 1 if overmanning occurred on project (<0.77), otherwise 0	1	2.6433	2.64
7. Overtime 1 if overtime used to complete change order work on project, is >10%, otherwise 0	1	1.1933	1.19
8. Actual Peak Manpower/Actual Average Manpower Actual Peak Manpower = 50 Actual Average Manpower = 30 Therefore Actual Peak/Actual Average Manpower = 1.67	1.67	1.2048	2.01
9. % Change Order Hours Related to Design Changes & Errors Percent design related change order hours as a percent	85	0.017154	1.46
SUM = X			**1.03**

The sum (X) is then inserted in the following equation (the simplified Impact Model):

$$\text{Probability (Y=1)} = \frac{e^{1.03}}{1 + e^{1.03}} \quad \text{OR} \quad \text{Probability (Y=1)} = \frac{2.80}{1 + 2.80} = .74$$

This implies good evidence of impact based on the following graph.



Now that we have a high confidence level that our project really was impacted by change orders we should apply our second model, the Quantification Model. To do this we insert the project specific data into the following table to determine the probable %DELTA.

Variables (1)	**Coefficient (2)**	**Value (3)**	**Product (4)**
Constant	0.36866	1	0.37
Percent Change (from previous table)	0.11957	0.45	0.05
PM%TimeOnProject	-0.08065	0.75	-0.06
%OwnerInitCI (number of owner initiated change items / total change items)	-0.16723	0.90	-0.15
Productivity (was productivity tracked?) Yes = 1, No = 0	-0.09147	1	-0.09
Overmanning (from previous table)	-0.05213	1	-0.05
Processing Time (from previous table)	0.022345	1	0.02
		%DELTA	**0.09**

OR

You could enter this information into the Quantification model below to derive the solution.

$$\%Delta = 0.36866 + 0.11957\ Percent\ Change - 0.08065\ PM\%TimeOnProject$$
$$- 0.16723\ \%OwnerInitiatedCI - 0.09147\ Productivity$$
$$- 0.05213\ Overmanning + 0.022345\ ProcessingTime$$

Substitution yields

$$\%Delta = 0.36866 + 0.11957(.45) - 0.08065(.75) - 0.16723(.9) - 0.09147(1) - 0.05213(1) + 0.022345(1)$$

$$\%Delta = 0.09$$

Regardless of which method you choose the resultant 0.09 implies that the project was probably impacted by 9.0% due to cumulative impact resulting from change orders. This equates to an additional 1,980 work-hours (22,000 X .09) beyond the estimated hours plus the approved change order hours (12,500 + 5,625), or 20,105 total work hours predicted. This is 1,895 work-hours less than the total work-hours submitted by Pandor Mechanical Contractors, but 1,980 work-hours more than Acme Fabricators initially wanted to pay them for. Is 20,105 work-hours the absolute right answer? Probably not, but it is the most likely answer based on our model, within a range of possible answers both above and below our predicted hours. It is at this point that the research team suggests that the Owner and Contractor sit down to review the hard data from the project and come to an agreement they both can be comfortable with.

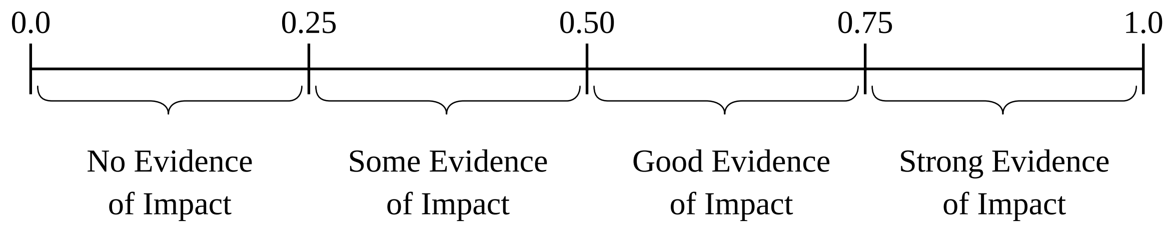
Change Order Impacts Blank Tool

Factor (1)	**Value (2)**	**Coefficient (3)**	**Product (4)**
1. Constant	1	-6.997	-7.00
2. Mechanical or Electrical 1 if mechanical, 0 if electrical		-1.0939	
3. Percent Change X (Mech_or_Elec) Percent change hours versus estimated project hours as a decimal multiplied by 1 or 0		3.889	
4. Estimated/Actual Peak Manpower Estimated Peak Manpower = Actual Peak Manpower = Estimated/Actual Peak Manpower =		-1.0371	
5. Processing Time Average period of time between initiation of the change order and the owner's approval. 1 = 1–7 days 2 = 8–14 days 3 = 15–21 days 4 = 22–28 days 5 = Greater than 28 days		0.6342	
6. Overmanning 1 if overmanning occurred on project (<0.77), otherwise 0		2.6433	
7. Overtime 1 if overtime used to complete change order work on project, otherwise 0		1.1933	
8. Actual Peak Manpower/Actual Average Manpower Actual Peak Manpower = Actual Average Manpower = Therefore Actual Peak/Actual Average Manpower =		1.2048	
9. % Change Order Hours Related to Design Changes & Errors Percent design related change order hours as a percent		0.017154	
SUM = X			

The sum (X) is then inserted in the following equation:

$$\text{Probability (Y=1)} = \frac{e^{1.03}}{1 + e^{1.03}} \quad \text{OR} \quad \text{Probability (Y=1)} = \frac{\quad}{1 + \quad}$$

Look at the graph below to determine where “Y” fits along the confidence line. This will give an indication of the confidence level that the project has been impacted due to Change Orders.



If the above model indicated that the project was impacted, then use the following table and model to predict to what extent the project was probably impacted.

Variables (1)	**Coefficient (2)**	**Value (3)**	**Product (4)**
Constant	0.36866	1	0.3687
Percent Change (from previous table)	0.11957		
PM%TimeOnProject	-0.08065		
%OwnerInitCI (number of owner initiated change items / total change items)	-0.16723		
Productivity (was productivity tracked?) Yes = 1, No = 0	-0.09147		
Overmanning (from previous table)	-0.05213		
Processing Time (from previous table)	0.022345		
		%DELTA	

Multiply the %DELTA by 100 to get the percent the work-hours were overrun.

OR

You could also enter the information into the Quantification Model below to derive the percent of overrun work-hours.

$$\%Delta = 0.36866 + 0.11957\ \mathit{Percent\ Change} - 0.08065\ \mathit{PM\%TimeOnProject}$$
$$- 0.16723\ \mathit{\%OwnerInitiatedCI} - 0.09147\ \mathit{Productivity}$$
$$- 0.05213\ \mathit{Overmanning} + 0.022345\ \mathit{ProcessingTime}$$

yields:

$$\%Delta = 0.36866 + 0.11957\ (\quad) - 0.08065\ (\quad) - 0.16723\ (\quad) - 0.09147\ (\quad)$$
$$- 0.05213\ (\quad) + 0.022345\ (\quad)$$

$$\%Delta =$$

Multiply the total work-hours submitted by the contractor by the resultant %DELTA to derive the predicted work-hours due to the "Ripple Effect." Add these work-hours to the sum of (estimated work-hours + approved change orders) to get the predicted total work-hours for the project. While we know that this is not the "absolute" correct answer, based on our model, it is the most likely answer within a range of answers both higher and lower than our answer. That is why we suggest that this be used as a starting point for negotiations while reviewing the hard data from the project.

Change Orders and Their Cumulative Impact

Cumulative Change Order Impacts Research Team

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Change Orders and Their Cumulative Impact

Plenary Slides

Partnering — A Success Thru CII Products

Case Study: Tennessee Valley Authority

Learning Objectives

- Learn how to establish tested relationships through team building that can be challenged and survive.
- Understand how to use Joint Project Teams for pre-planning and successful execution.
- See how partnering demonstrated continuous improvement with results beyond initial expectations.
- Hear about measures to continuously improve performance, maintaining results while maintaining team health in a long-term relationship is possible.

Abstract

This case study will identify the value of a true partner relationship to explore and build upon best practices with measurable results. Objective data will be presented to demonstrate effectiveness of partnering utilizing pre-planning, continuous improvement (TQ), and team building to overcome performance barriers without tearing down team relationships. Metrics will be presented that show achievements from 20-50%; will include discussion on what works and what does not work.

Plenary Session Presenter

C. Robert Seay – Manager, Partnering Alliances, Tennessee Valley Authority

Bob Seay is Team Leader for the Production Support Peer Team with the Fossil Power Group of the Tennessee Valley Authority. He has over 26 years of experience in power plant construction, modification, and fabrication. Since 1991, he has had responsibilities for the development, implementation, and management of partnering contracts to perform major maintenance and modifications work with the TVA Fossil and Hydro System. He has experience in nuclear construction and startup as well as experience as a planning engineer and a quality engineer. Bob holds bachelor's and master's degrees from Memphis State University.

Implementation Session Moderator

C. Robert Seay, Manager – Partnering Alliances, Tennessee Valley Authority

Implementation Session Participants

E. Haley, Production Supervisor – Tennessee Valley Authority

Nick Mangiamele, Partner Site Manager – NPS Energy Services, Inc.

Lee Nash, Project Engineer – Tennessee Valley Authority

Harry W. Sauer, Vice President & Program Director – Parsons Energy & Chemical Group

Partnering — A Success Thru CII Products

Do's & Don'ts

Enclosed are some TVA/GUBMK/NPS Lessons Learned we have experienced throughout our nine-year history with Partnering and implementation of best practices.

Our panel members are here to answer questions and to provide their insights and perspectives on the four areas addressed in our presentation. We hope that you can benefit from their experience.

Moderator:	Bob Seay, Manager Partner Alliance Team TVA
Panelists:	Harry Sauer, Program Director GUBMK
	Lee Nash, Manager Projects and Discipline Engineering
	Nick Mangemele, Site Partner Manager NPS, Allen Fossil Plant
	John Haley, Production Supervisor TVA, Allen Fossil Plant

The Do’s & Don’ts

Partnering

Do

- Prepare the work force for what is coming.
- Use as a forum for exploring new initiatives.
- Assure that you have owner executive commitment and involvement and that this is consistent when there is new leadership.
- Make it a formal strategy/process.
- Communicate what is intended and reinforce it regularly to both the owner and contractor part of the team.
- Involve the owner direct customer in the process—they are the ones who will implement the strategy and be measured by it.
- Be patient: it takes time and commitment.
- Put the metrics in place to measure the results so that you can demonstrate whether or not the results are better. Use hard measures: the soft ones aren’t convincing.
- Develop team loyalties that can overcome individual company cultures and focus on objectives of the partnership.
- Establish and take ownership of joint proceeses and procedures.
- Become involved in plant management teams such as business planning, safety, labor, etc.
- Be a visable champion and leader of the partnering processes and business objectives.
- Share common goals that the team can rally around.
- Recruit the right people—pay attention to chemistry.
- Use a unique or customized contract selection process.

Partnering

Don’t

- Assume that only the owner’s team requires training in partnering.
- React to every “story” you hear about problems—most will be self-serving and not factual. Address issues on their own factual merit.

- Underestimate what it will take in terms of effort and attention to achieve the benefits. It takes 4–5 years!
- Assume that after several years the concept is institutionalized and new team members will come on board without indoctrination and reinforcement
- Accept excuses or lack of ownership from people or organizations not being accountable for their responsibilities.
- Confuse efforts with results.
- Allow personal agendas to change the partnering landscape.
- Hold the partner accountable for things he cannot substantially impact or change.
- Tie partner fee to indicators he cannot control or substantially influence.

Pre-Planning

Do

- Identify upfront objectives, expectations, and authority of the planning team.
- Communicate any pre-established targets
- Use a required formalized process
    - Conduct training in how to use it
- Continually follow-up and re-enforce expectations
- Be flexible, change what doesn't work well after a reasonable trial
- Assure that the process has sponsors or champions in the direct accountable part of the owner organization
- Ensure the team and process application is all inclusive.
- Enforce the use of action-item list for primary and secondary responsibilities.
- Stress that all levels of supervisors and managers plan in safety on a continuous basis.
- Enforce due dates on action item list as late dates.
- Follow a formalized work package standard representing best practices in application
- Identify lead accountabilities through out all phases of the project.
- Emphasize that success is achieved when opportunity meets preparedness.

Pre-Planning

Don't

- Assume that your team knows how.
- Assume that everyone is in favor of planning—most like flexibility, which often means to do what they want when they want.
- Underestimate the persistence it takes to make it work for you.
- Be influenced to using only parts or pieces of processes in order to suit one's needs. Systemwide standardization is essential.
- Be trapped into silos. Never say "it's not my job." Remain team focused.
- Under-fund engineering thus creating "just-in-time solutions."
- Tolerate partial compliance with project readiness processes and expectations
- Request "aggressive" estimating and later hammer the team for being "marginally" over the estimate.

Team Building

Do

- Be willing to make the investment.
- Recognize the "total team" involved to be successful.
- Establish expected team behavior.
- Do it early in the process and assure you involve all levels: follow the partnering model.
- Use an independent facillitator for "high risks" or "gravity" type issues.
- Reinforce on a regular basis.
- Use different techniques, the same one repeatedly looses effectiveness.
- Provide a "menu" of tools or options to fit specific needs.
- Seek first to understand before being understood.
- Review team health thermometer on a regular basis.
- Teach and learn levels of listening skills using the "be here now" concept.
- Continue team-building sessions on a periodic but ongoing basis.
- Continue post-outage/project critique sessions with partner and plant personnel.
- Get partner involvement in plant activities and events.

- Communicate reasons for controversial or unpopular management decisions to subordinates in an effort to foster support and understanding.
- Encourage cross polination and participation in organization meetings in an effort to stimulate an open exchange of ideas.

Team Building

Don't

- Proceed without a strategy!
- Cut short because of time and cost; it will pay back.
- Allow unstructured, "we know how to do it" sessions. It wastes time because those who say this don't want to do it in the first place: They see it as losing control.
- Start work without it: It will cost in the long run.
- Allow focus on fee as a driver. (Focus the team on objectives and results and build your fees aroung those.)

Continuous Improvement

Do

- Focus on and follow performance indicators, make goals and targets a stretch but reachable.
- Tie the metrics to what is important to both the owner and the contractor.
- Make sure incentives are properly aligned.
- Protect the partner from site owner "wish lists."
- Provide tools to support the process, e.g., Lessons learned database, joint post project review meetings, formal reconciliations of project scopes, etc.
- Avoid the victim mentality, e.g., "The crafts are different here,….. This site is different,….. Their numbers must be wrong,…… That's not what I heard,…."
- Be flexible: Not everything you try will work.
- Reinforce the concept and key processes at the team building.
- Obtain executive commitment from both the owner and the contractor to the concept and the specific measures.
- Build your team with personnel who enjoy the challenge of continuously doing better
- Use a standard process for collection and distribution of "lessons learned"; incorporate into the approved readiness process.

- Review team health thermometer to stimulate team communication
- Meet with and involve a broad spectrum of personnel to develop ideas to improve work methodology, performance, and lower cost.
- Establish a multi-project or systemwide “peer team” to stimulate exchanges in experiences and stimulate consistency in company wide team growth.

Continuous Improvement

Don’t

- Allow the team to be dominated by “good enough” players.
- Accept status quo, e.g., “We have always done it this way.” Be innovative and creative.
- Allow expectations to be a barrier. You can often do much better than just incremental improvement!

Knowledgeable Point of Contact

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Partnering — A Success Thru CII Products

Plenary Slides

What Can CII Do for You?

First-Time Attendee Orientation — Implementation Session Only

Learning Objectives

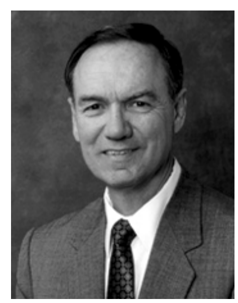
- Obtain an overview of the background origin of CII and its continued evolution.
- Gain a better understanding of CII and the breadth of its current and planned activities.
- Learn specific details of the CII research process, implementation efforts, and educational opportunities.
- Learn how CII member companies have benefited from implementation of CII tools and best practices.

Abstract

This implementation session is designed for first-time attendees, prospective CII members, and others who would like to gain a broad understanding of CII and its many activities. CII Director Ken Eickmann will lead this special implementation session (no plenary presentation will be provided and the session will be conducted on Wednesday afternoon only). The session will provide detailed information on how CII is organized and what the primary core processes entail. The session panel includes four current members of the CII Executive Committee who will offer their insights on how their companies have benefited from CII membership.

Implementation Session Moderator

Kenneth E. Eickmann – Director, Construction Industry Institute



Prior to joining CII as Director in September 1998, Ken Eickmann (Lt. Gen., U.S. Air Force, Retired) enjoyed a distinguished and highly decorated 31-year career in the U.S. Air Force. Ken is a Registered Professional Engineer and a Certified Acquisition Professional in acquisition logistics, program management, and systems planning, research, development, and engineering. He is a Senior Lecturer in Civil Engineering at UT Austin. He holds a bachelor's degree in mechanical engineering from UT, a master's degree in systems engineering from the Air Force Institute of Technology, and is a graduate of the University of Michigan School of Business and the John F. Kennedy School of Government, Harvard University.

Implementation Session Panelists

William W. Brubaker, Director of Facilities Engineering – National Aeronautics & Space Administration

Robert D. Couse, Principal Vice President & Manager of Operations, Fossil Power – Bechtel Power Corporation

Kenneth E. Hall, General Manager – Central Engineering Department, Texaco, Inc.

Harold L. Yoh III, Chairman & Chief Executive Officer – The Day & Zimmermann Group, Inc.

What Can CII Do for You?

Knowledgeable Points of Contact

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eBusiness Is Business — Get On with It

Keynote Speech: Jeffery L. Peterson

Jeffrey L. Peterson is vice president of DuPont e-Business, with responsibility for DuPont's e-Business Center and for assisting DuPont businesses in taking advantage of e-commerce opportunities.

Mr. Peterson joined DuPont in January 2000. Immediately prior to joining DuPont, he was vice president of e-Commerce/e-Technology for GE Capital, where he had responsibility for defining and building the company's worldwide e-commerce capability and organization.

In 1989 he became program director for Technology and New Ventures, Management Systems Laboratories, Virginia Tech. From 1993 to 1996 he was vice president of Strategic Technology Planning at Crestar Bank, Richmond, Virginia. He then led the creation, startup, and sale of NetImprovement, a company focused on the business application of Internet to small and mid-sized companies.

Jeff is a graduate of Virginia Tech and holds a master's degree in technology management from MIT.

Benchmarking in the Information Technology Age

Benchmarking & Metrics Committee

Learning Objectives

- Learn about the new web-based data collection — improved accuracy, reduced cycle time, and user friendly.
- Gain immediate feedback on the quality of your front-end planning activities with on-line scoring of the PDRI.
- See how real time Key Reports can provide project level feedback to guide project performance.
- Understand how CII Knowledge Team activities are driving the development of metrics and analyses.
- Hear how member companies are leveraging their benchmarking experiences to improve project results.

Abstract

CII's Benchmarking & Metrics program is now using web-based technology to influence project outcomes. Project managers can input data as the project unfolds and compare planned practice use to actual project experiences in the CII database to determine those critical practice tasks that can improve performance. Results from the first CII Benchmarking User's Forum, a presentation of new performance and practice use metrics, and new technology-enabled advances will illustrate progress being achieved towards the Committee's Vision 2002.

Plenary Session Presenter

David G. Hile – Director of Business Development, Cherne Contracting Corporation

Dave Hile is Director of Business Development for Cherne Contracting Corporation in Minneapolis, Minnesota. He joined the company in 1980 as a project controls engineer, working in several locations in the U.S. In 1985, he moved to company headquarters in Minneapolis as project controls manager, and was named Director of Business Development for Cherne in 1996. In his current position, he establishes and maintains new business development relationships in the refining, chemical, power, and pulp and paper industries for Cherne. Dave is a member of the CII Board of Advisors and is co-chair of the CII Benchmarking & Metrics Committee. He holds a bachelor's of science degree from Indiana State University.

Implementation Session Moderator

Dave G. Hile, Director of Business Development – Cherne Contracting Corporation

Implementation Session Panelists

Robert A. Herrington, Quality Manager - Houston – Jacobs Engineering Group, Inc.

Stephen R. Thomas, Associate Director – Construction Industry Institute

Chad L. Zollar, Consulting Engineer – International Paper Company (Champion)

Benchmarking in the Information Technology Age

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Benchmarking in the Information Technology Age

Plenary Slides

Forecasting and Minimizing Field Rework

Effects of Field Rework Research Team

Learning Objectives

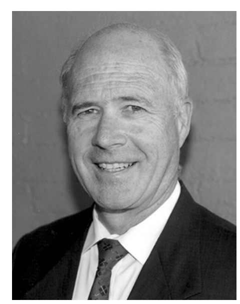
- Find the factors that influence field rework and how controlling these will permit a project team to minimize the amount of field rework.
- Realize that reducing the level of field rework can have a significant influence on total project cost.
- Learn how to recognize some of the characteristics of projects that experience high and low field rework.

Abstract

Conclusions from this research and the development of the Field Rework Index (FRI) will be presented. The FRI tool will be explained, including the 13 to 19 influence factors. Research shows that the level of field rework can be predicted early in a projects life cycle, and that the amount of field rework experienced by a project can have a significant impact on the overall project cost.

Plenary Session Presenter

James L. Atkinson – Manager of Engineering, Fairfield Works, U.S. Steel



Jim Atkinson is the Manager of Engineering at U.S. Steel's Fairfield Works near Birmingham, Alabama. He has been with USX since 1967, and has served in various capacities and for projects exceeding $1 billion at the plant. Jim has twice served as national director of the Association of Iron and Steel Engineers (AISE). He also has been nominated as Alabama Engineer of the Year (1996). He is the author of numerous technical papers on the Fairfield Works. A registered professional engineer, Jim is a civil engineering graduate of Mississippi State University.

Forecasting and Minimizing Field Rework

Knowledgeable Point of Contact

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Forecasting and Minimizing Field Rework

Plenary Slides

The I/A Implementation Index

Center for Construction Industry Studies

Learning Objectives

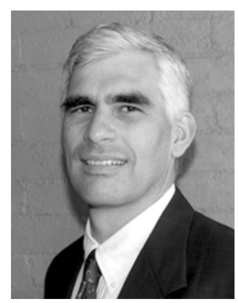
- Learn the extent of industry progress toward achieving the fully integrated and automated project processes (FIAPP) vision.
- Learn the project types and work functions that are the most advanced, the least advanced, and the most variable.
- Consider several ideas on what the industry needs in order to progress in integration and automation.

Abstract

CCIS will address one of its FIAPP metrics objectives — to characterize the extent and scope of the implementation of task automation and task-to-task integration technologies across the industry. Industry technology implementation successes and continuing challenges are presented at the project type and project work function levels.

Plenary Session Presenter

James T. O'Connor, Jr. – Professor, The University of Texas at Austin



Jim O'Connor is the C. T. Wells Professor of Project Management in the College of Engineering at The University of Texas at Austin. Prior to his doctoral studies, he held a variety of industry positions in project engineering, cost and schedule management, and site quality control. He has been active in CII since its inception, serving on the Constructability Task Force from 1985–88. He also was a member of the CII Planning for Startup Research Team. He currently serves on the Research Committee. Dr. O'Connor has received numerous awards, both nationally and abroad, for his research and service contributions. He is a graduate of Oklahoma State University, the University of Illinois, and The University of Texas at Austin.

The I/A Implementation Index

Knowledgeable Points of Contact

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The I/A Implementation Index

Plenary Slides

RFID Applications for Owners and Contractors

Radio Frequency Tagging Research Team

Learning Objectives

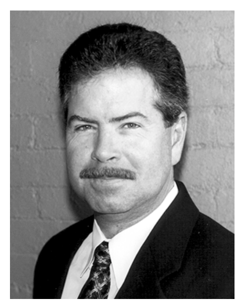
- Learn about the radio frequency identification (RFID) technology.
- Discover where RFID can be used in a construction and facility operation environment.
- Explore how this technology can help your company improve productivity, cost, schedule, quality, and safety.

Abstract

Radio frequency identification is an identification system technology that is successfully being implemented in many areas outside the construction and facility operation environment. It is a mature technology that should be considered for use by owners and contractors as a way to improve the efficiency of site operations. An overview of the technology is provided including definition, components, costs, benefits, and limitations. Results of an industry–RFID supplier workshop will be presented to help disseminate information regarding the technology. Pilot tests' results also will be presented for both contractor and owner applications to demonstrate RFID's potential usefulness related to receiving materials, tracking "smart instruments," maintaining pressure relief valves, and enhancing efficiency of operator rounds. RFID in the fully integrated and automated project process (FIAPP) also will be discussed.

Plenary Session Presenters

Carl E. Lake – Manager of Construction, Bechtel Group, Inc.



Carl Lake is Manager of Construction for all telecommunication and e-commerce work for Bechtel in the U. S. He has been with the company since 1978, when he joined the firm as a field construction engineer. Since then, he has worked in all areas of field construction and construction management in the refining, chemical, defense, mining, telecommunications, and e-commerce industries. Carl holds a civil engineering degree from the University of Oklahoma and a master's degree from Stanford University.

Edward J. Jaselskis – Associate Professor, Construction Engineering, Iowa State University

Ed teaches courses in project management, contract documents, construction materials and methods, estimating, and pre-project planning. His research expertise is in the areas of innovative construction technologies and construction project success. He has worked for Exxon as a cost/schedule engineer and field engineer and recently completed an internship with Bechtel as an office and civil field engineer on Bechtel's Brandon Shores SCR Project. Ed holds degrees from the University of Illinois at Champaign-Urbana, MIT, and The University of Texas at Austin. He is a Registered Professional Engineer.

Implementation Session Moderator

Edward J. Jaselskis – Associate Professor, Department of Civil & Construction Industry, Iowa State University

Implementation Session Panelists

Rakesh Agrawal, Vice President – Piping Technology & Products, Inc.

Chris Q. DeLeon, Electrical Engineer – Rohm and Haas Company

Don Frieden, Business Development Manager – SAT Corporation

Ron Mathews, Manager of Field Procurement – Bechtel Corporation

William C. Stone, Group Leader, Construction Metrology & Automation – National Institute of Standards & Technology

Clark W. Stuart, Manager, Materials Management – Black & Veatch

RFID Applications for Owners and Contractors

Introduction

Radio frequency identification (RFID) refers to a branch of automatic identification technologies in which radio frequencies are used to capture and transmit data from a tag or transponder. These tags are typically affixed to assets to assist in the identification and tracking process. Specific applications have already been developed in many areas such as vehicle access, personnel identification, asset tracking, livestock identification, and tolls and fees [1]. Development is currently underway in areas related to baggage identification in airports, groceries, and postage stamps. RFID technology, unlike bar code labels, is more robust in the sense that tags do not get damaged as easily and can be read in direct sunlight and other harsh conditions. RFID tags also have the ability to store data and retrieve it at a later time. This technology has significant potential in enhancing several processes in the construction and facility operations environment.

Purpose

The purpose of this ongoing CII research project is to bring information regarding RFID technology to CII member companies so that they will be able to take advantage of this emerging technology as it becomes commercially available. It will also provide manufacturers with important information regarding the needs of the construction industry so that their future products better address the industry's needs.

Scope

The scope of this research project includes:

1. Providing CII member companies with a better understanding of RFID tagging technology (what it is, how it works, benefits, costs, and current applications).
2. Understanding CII member company needs in terms of what applications will best suit their needs, the type of data that should be stored on each tag, and barriers to implementation.
3. Pilot testing applications in the construction and owner facility operations environment.
4. Providing an assessment of how RF tagging technology can incorporated into a fully integrated and automated project process (FIAPP).

Description

RFID technology involves the use of tags or transponders that can: collect data and manage it in a portable, changeable database within the tag; communicate routing instructions and other control requirements to equipment; and withstand harsh environments. It can be viewed as a sister technology to bar code labels that use radio waves instead of light waves to read a tag.

Two components comprise an RFID system: 1) Tags or transponders and 2) the reader. The tag contains a small integrated circuit chip and an antenna that is encapsulated in a protective shell. The reader contains, at a minimum, a scanner and antenna. Tags can be made very durable, chemical resistant, and non flammable (refer to Figure 1). Readers come in all different shapes and sizes from handheld units such as the Telxon reader to portal readers that can be found at store entrances (refer to Figure 2).

Figure 1. RFID Tags

HID Portal Reader Telxon Reader

Figure 2. Readers

RFID uses low-power radio frequencies instead of laser light used for reading bar code labels. These broadcasted radiowaves do not require a direct line of sight; they travel easily and do not have to be in contact with the device that reads the radio signal. Figure 3 shows how this technology works. The reader sends energy to the tag (A) and the tag sends identification data back to he reader (B). The reader decodes the data and transmits it to a computer for inclusion in the facility information system (C).

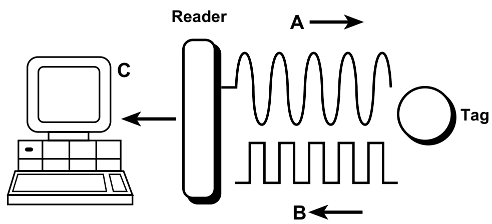


Figure 3. How RFID Works

Tag Classification

RFID tags are classified as active or passive tags and may have read-write or read-only capability. Active tags contain a battery that powers the tag. Active tags can be read or written to from approximately five to 100 feet; however, active tags are generally more expensive than their passive counterparts and have a limited three to ten year life. Passive tags, on the other hand, are powered solely by the magnetic field emanated by the reader and have an unlimited lifetime. Some active tags are being produced that use the incoming radio signal to recharge their internal battery, extending their life beyond ten years [2]. Read and write ranges for passive tags are generally less than six feet; in most configurations, the read range is only two to twelve inches.

Read-only tags are programmed either during manufacture or by the user once during their lifetime. The information programmed onto read-only tags cannot be altered at a later time. Read-only tags are generally used for simple identification purposes and hold approximately eight to 128 bits of memory. With read-write tags, as the name implies, the user can alter the information stored within the tag. There are also write-once, read many (WORM) formatted tags that are essentially read-only. The user can program them one time after manufacture. The memory capacity of read-write tags varies from 64 to 32,768 bytes where one byte equals 8 bits of binary code (i.e., “0” or “1”); this represents several pages of text [3].

Benefits

The primary benefits of using RFID are its ability to operate in a non line-of-sight capacity and to store data in a changeable database. Moreover, while other identification technologies rely on optics and require a relatively clean and moisture-free environment, RFID technology is ideal for dirty, harsh, hazardous environments. RFID can also survive temperatures ranging from minus 40 centigrade to 200 degrees Centigrade [2]. The technology is also very reliable and can operate flawlessly for an extended period of time. Passive tags have an extremely long life and usually last longer than the object itself, making it suitable for use in hazardous waste material container tracking and identification. Moreover, data security is high as it is very difficult to copy the code.

Costs

Costs for this technology vary depending on the application. Passive tags cost between $1.00 and $150 each. Active tags can cost up to $250 each. Reading units generally cost between $200 and 10,000 but generally cost around $4,000 each. Software development can range from a low $100 (for minimal programming requirements) to several thousand dollars for development of customized software applications.

Limitations

One of the key limitations of this technology is the lack of standardization. Presently, each RFID supplier has its own proprietary technology for reading and writing to the tags. In general, it is not possible for one manufacturer’s tag to be read by another company’s reader. In other words, RFID systems would work well in a closed environment but would not function well in an open environment as is envisioned for application in the construction industry. Furthermore, metal hampers RFID tag operation by blocking and canceling signals; thus, it would not be possible to read a tag through a steel beam. There is also potential for interference from other radio frequency systems as well as possible damage to tags exposed to temperatures above 200 degrees Centigrade. Lastly, active tags will most likely require a battery management program to ensure that batteries with sufficient energy are powering the tags.

Construction Industry–RFID Supplier Workshop

A construction industry–RFID supplier workshop was held to disseminate information about this technology and generate suitable application ideas for the industry. Thirty-one people attended the workshop including representation from both CII owner and contractor firms and four RFID supplier companies [Brady RFID Systems, HID, Intermec-Amtec, and SAT Corporation (formerly Safetrac Control Systems)]. Potential application areas discussed by participants included material management and procurement (e.g., material receiving, installation, and start-up and commissioning), field operations (e.g., personnel management, time keeping, handling certification for mechanical machinery, and fleet management), and maintenance (e.g., inspection, repair history, operating data, and compliance records). Moreover, several important points were identified from the workshop:

1. RFID has its strengths and limitations.
2. There are few construction-related RFID suppliers.
3. RFID should be used with the larger company information system (FIAPP).
4. Bar code labels and RFID tags should be considered complimentary technologies.

RFID Pilot Applications

With the information gathered during the workshop, application ideas were selected and pilot tests were conducted to learn more about RFID and its applicability to the construction industry. One contractor application was explored related to receiving pipe supports on a jobsite. Three owner applications were tested on existing plant facilities related to (1) tracking smart instruments, (2) maintenance of pressure relief valves, and (3) operator rounds and mechanical integrity inspections. The National Institute of Standards and Technology (NIST) also conducted an experiment using RFID to track steel components on a jobsite. These tests involved the use of passive RFID technology in the 135 Khz frequency range. Each of these applications is described in more detail below.

Contractor Pilot

The contractor pilot involved receiving pipe supports and hangers on two Bechtel jobsites using RFID tags. The first was the Red Hills power plant in Ackerman, Mississippi. The second was related to the construction of a catalytic cracking unit at the ExxonMobil Baytown Refinery in Baytown, Texas. Material receipt is one component of the life cycle where this identification technology could succeed and make some improvement. The current approach involves unloading and shaking out pallets of supports and hangers, manually “kicking and counting” items and checking them against a packing list, and manually entering data into a material tracking system called PTS (Bechtel’s Procurement Tracking System). This process is time consuming and prone to mistakes.

With the RFID approach, an RFID tag is placed on the pipe support at the supplier’s fabrication plant (Piping Technology and Products). Pallets are still unloaded and shaken out as with the manual approach. Workers use a Telxon reader to read and write information to the tag. SAT Corporation provided the readers that were programmed to suit this application. The Telxon reader is a very flexible computer in terms of its windows interface. It also has an RFID tag reader on the right hand side of the unit. Workers were trained in the use of the equipment prior to the test. Using the RFID approach, only one worker is required to kick and count the pipe supports instead of two using the manual approach. The worker scans the tag and populates the screen with information related to the pipe hanger’s purchase order number, release number, and requisition number. Three questions were answered related to the quantity, the condition, and the storage location of each hanger. This information was then written back to the tag for later use. Once all tags had been scanned, the last step in this process involved saving the file that has all tag information and downloading it to the procurement tracking system (PTS).

The characteristics of each test differed. On the Red Hills project, the research team received 28 supports that had a unique RFID tag. On Bechtel ExxonMobil project, there were approximately 100 line items representing about 800 supports. In this case, tags were attached to only one of several similar items. Figure 4 shows a worker using the RFID approach to receive pipe hangers at the Red Hills project. Notice how each pipe support/hanger has its own unique RFID tag. Figure 5 shows a pallet of bulk items that were received on the Baytown project. Note how there is only one tag per unique support (lower right corner).

Figure 4. RFID Approach Used to Receive Pipe Hangers at Red Hills

Figure 5. RFID Approach Used at the Baytown Project

Table 1 summarizes the time required to unload, “kick and count,” and enter data into PTS using both the manual and RFID approaches for the Red Hills project. Note that time was saved both in the verification process (primarily since only one worker was required) and in the download time into the PTS system. A more qualitative analysis is provided for the Baytown project due to the difficulties encountered attempting to time this test.

The primary strengths identified were related to time savings, workers liked the technology, and the fact that a “flag” is written to a tag indicating a received item. Another benefit to RFID technology is its ability to be used in harsh conditions. Sunlight can interfere with the bar code scanner whereas this is not the case for RFID technology.

Table 1. Red Hills Time Comparision

Method	Manual (minutes)	RFID (minutes)
Time required to unload 100 hangers (see note 1)	107	107
Time required to verify 100 hangers	356	242
Time required to enter 100 hangers into PTS	52	20
Total time required	**515**	**369**

Note 1: The 28 hangers were normalized to 100

The primary limitations experienced with this technology related to the read distance and interference with metal objects. The actual read distance was approximately one to three inches. This required the worker to bend down and get within close proximity to each tag in order to both read and write to the tag. The workers complained of sore knees after the pilot test was completed. Also, metal objects such as the wire ties used to attach the tag to each pipe hanger created interference that made it difficult to read and write to tags. This was particularly the case when the wire tie was wrapped across the top of the tag. In these cases, the reader antenna had to be positioned underneath the tag in order to properly scan the tag.

Owner Applications

In addition to assisting with the contractor pilot tests, SAT Corporation performed three owner application pilot tests related to tracking smart instruments on Rohm and Haas' Deer Park, Texas F4 construction project; tracking pressure relief valves on the ExxonMobil Corporation, Torrance, California maintenance turnaround project; and enhancing operator rounds at the ExxonMobil Torrance, California refinery. The following is a more detailed description of each owner application.

Rohm & Haas F4 Project

This project involves the use of RFID tags attached to Honeywell smart instruments to more efficiently track them throughout the installation process: (1) receipt (e.g., verification of manufacturer, model number, and physical damage); (2) issuance (making sure stainless steel tag is properly installed and determining where the instrument should be assigned); (3) mounting in the field (checking for correct location and possible interference); and (4) installation including the conduit, tubing, and loop check all per the plans and specifications. Presently, Rohm and Haas has experienced some difficulties with not being able to locate instrumentation in the warehouse or technical shop. Also, instruments have been installed in the wrong location.

In the test, approximately 80 smart instruments were shipped with tags attached to the middle of each instrument. Essentially, the user begins by reading the tag and answering questions related to the process that is being checked. Questions are posed depending on the process. Such as, “Is the wiring completed?” Data were then downloaded into the database so that the process progress can be tracked.

Several benefits were derived from using RFID tags on the smart instruments. Project management was better able to know the status of each instrument. There was also a reduction in inventory shrinkage during the construction process because Rohm and Haas was able to better manage the process. Additionally, rework costs were lowered because Rohm and Haas was actually able to verify the instrument more efficiently and track the installation stage more accurately.

ExxonMobil Maintenance Turnaround

This application involved tracking pressure relief valves during a maintenance turnaround on the ExxonMobil Torrance Refinery. The refinery maintenance staff felt that there was a need to keep track of the relief valves through the maintenance process. RFID technology was selected over barcodes due to improvements in the technology (e.g., read/write capability, intrinsically safe, and more memory at a lower cost) and an interest from the refinery in testing this technology. Pressure relief valves require testing and recertification to ASME code on a periodic basis. This requires the valve to be taken out-of-service and tested or tested in place with special test equipment. Having the capability to read the information off the tag and write it on the tag (e.g., last test date) and keeping track of that piece of inventory is a key part of asset management.

In the pilot, a RFID tag was placed at the location of each relief valve; relief valves were then removed and sent to Dresser’s maintenance facility where they were tagged. The repair shop read the tags and initially kept an electronic copy and hard copy (dual documentation). If there were any changes to the valve (e.g., internals), the tag was interrogated and the correct data was read to it. Dresser transmitted all information electronically to the ExxonMobil database.

Tags were loosely attached to equipment using one wire connection on the top of the piece of equipment. Dresser learned that tags that are allowed to be loosely affixed to a valve stay cooler over time but the wire connector tends to break and the tag falls off. In the future, Dresser will make sure it has two connections to the tag rather than one.

Training the people in the repair shop was also a key issue. There is a certain orientation where the signal is the strongest and can read the tags the fastest. The read zone is shaped like a 3-dimensional clover leaf on each end of the tag. In other words, there are some dead zones where a read or write procedure is not possible. Dresser trained the shop people to know where the tag is in the enclosure (actually lays in at an angle). People can mistakenly read the tag at one location and say the tag is no good — but in other places they would be able to communicate with it.

Computer literacy was also a concern. The maintenance shop was a fairly small facility with limited staffing and equipment. Up to this point, maintenance employees have not required much computer expertise. Thus, some basic training on computer system and software was necessary.

Furthermore, Dresser found that the tags were more reliable in high temperatures than originally anticipated. This is despite the fact that manufacturers caution tag users that data might be lost at certain temperatures. This is particularly an issue in refineries where temperatures might be as high as 200 degrees Centigrade. One of the fears about losing data had not occurred in practice. It was discovered that some of the polypropylene tags were melting at 400 degrees Fahrenheit. Mobile mounted the tags on the inside instead of the outside of the insulation-temperature guns verified that the temperature was around 695 degrees Fahrenheit. Dresser found that it could still read the data off of the tags even after they had been exposed to these high temperatures.

Results showed that Dresser did not obtain much productivity improvement during the pilot test due to opportunities for better planning. As with any new work process which involves people doing things differently, one needs to very carefully plan out the work process or business process in such a way that people clearly understand what is required of them. Before getting started, this work process planning activity is the most important activity to perform. This helps the team better plan the test; it is important to have problems solved on paper first.

Benefits were experienced by both ExxonMobil and Dresser's valve maintenance facility. ExxonMobil was able to reduce rework related to positive valve identification. Dresser improved its ASME record keeping process through the RFID's electronic data capture capability. Furthermore, start up time was reduced.

Operator Rounds and Mechanical Integrity Inspections

SAT Corporation has developed an RFID application for tracking equipment from acquisition to disposal to improve mechanical integrity and safety requirements in process plant facilities. Presently, ExxonMobil is tracking equipment such as pumps, motors, valves, and other safety equipment using RFID technology on its Torrance, California refinery. As an added benefit, this RFID application is being used to make sure operators properly perform their rounds by providing verification that operators are collecting data on the required pieces of equipment.

Some lessons were learned from this application. The key to successful implementation of RFID technology is providing adequate planning for such an innovative project process. Furthermore, the reliability of the tags improves when they are mounted properly. Care should be taken to avoid areas with extreme temperatures and the possibility of physical damage. Proper training is required so that workers use the technology with the highest level of efficiency. Plant operators liked the ability to store data on the tag but they needed more guidance on how to best use this data. Also, it was necessary to place a visual identification on the tag (e.g., serial number) to help workers more effectively carry out their rounds.

NIST Application

The Construction Automation and Robotics Group at the National Institute of Standards and Technology (NIST) is researching RFID tags for automatic identification of structural steel components on construction sites. This endeavor is part of a larger research project, Real Time Component Tracking System (Comp-TRAK), which involves developing a web-based system for rapidly tracking, identifying, and locating manufactured components on job sites. The approach involves the use of RFID and barcode identification systems, 3D long range coordinate measurement technologies, portable/wearable computers, wireless communications, high speed networking, temporal project databases, web-based data analysis, and 3D user interfaces to provide as-is and as-built component data at the actual construction site.

Present research is focused on developing and testing the prototype tracking system during the construction of a six million dollar emissions control system addition to an existing building on the NIST site. Steel components scheduled for arrival on the construction site are tagged using bar code and RFID tags. Some parts are tagged at the galvanizing shop to test their ability to withstand loading, transport, and unloading; others are tagged when they first arrive at the jobsite. Each structural steel part has been assigned a unique identifier in the project database (using the steel fabrication drawings as a guide), which is encoded in the attached tags. The encoded information is scanned directly into a portable computer and is wirelessly relayed to a remote temporal project database. The project database is a repository of transient information associated with the steel parts. Information relating to the scanned part, such as a full description, manufacturer’s specifications, and reference documents is returned to the field worker. Some of this information may be programmed and/or updated on the RFID tags; NIST is working with the construction contractors to determine what information they would find useful to have directly attached to the component, versus, or in addition to, being stored in a project database.

The pilot involves the use of a “stand-alone” belt-wearable reader with separate power source supplied by SAT Corporation. This reader and antenna combination are capable of scanning a tag five to eight inches away. RFID tags are scanned and information from a remote database can be viewed on the portable computer screen related to the component’s identification number, name, manufacturer, reference document, and link to view the CAD model. By collecting enough fiducial points on the component, it is possible to determine the actual three dimensional spacial model of the object.

Presently, steel has been tagged in the laydown area with the RFID tags. Preliminary results show that there was some difficulty reaching tags that were blocked by another piece of steel especially when the steel was stored in bundles. Furthermore, it was discovered that the RFID tags can become detached fairly easily even when using a two-part epoxy glue. Some type of mechanical fastener may be required. There were no instances of an incorrect read. A no read error occurred when two tags were close to the reader. Additional results will be forthcoming at the annual conference.

RFID in a Fully Integrated and Automated Project Process

One of the objectives of this research project was to investigate ways to integrate RFID technology throughout the project lifecycle to improve productivity, cost, schedule, quality, and safety. In other words, the research team was chartered to determine how RFID can fit into a fully integrated and automated project process.

Several applications were identified in the constructor and owner environment. Personnel accountability could be used for tracking time and attendance. The RFID tag can be encoded with personal employee information that could be used in emergency situations. On the safety side, we could take analyzers and instruments used by the safety division and encode certification and calibration information on those instruments. RFID tags could also be attached to rigging and equipment such as slings, come-alongs, and chain falls. These tags could be encoded with the latest load data information so field personnel could have rapid access to this information prior to lifting operations. In the area of preventative maintenance, tags could be encoded with attributes such as preventative maintenance schedules, lubricants, and desiccants on each of the components. Contractor fleet management programs can benefit from using RFID tags in the areas of gate control and maintenance and asset tracking. Measuring and test equipment could have the latest calibration information on each instrument prior to performing any inspection or test procedure. From quality standpoint, RFID can be used to retrieve data such as code data for ASME components and mill test certification reports.

Asset management would provide the greatest benefit from the owner's perspective. RFID tags could be required at the point of manufacture and would be encoded with specific information by the manufacturer that would be used by the contractor upon receipt and inventory control at the site. This would include preventative maintenance requirements and that would apply throughout the life of the component during the storage cycle of the project. At the time the asset is turned over to the owner, that information owner can use the RFID tag on the component to track the life of the asset during maintenance of the asset.

Conclusions

Radio frequency identification is becoming more popular as a tagging and identification technology. Aside from its relatively large storage capacity (compared to bar codes) it is very reliable and more robust in harsh environments. This technology also has a high level of security as it is nearly impossible to replicate tag information. Several applications have already been successfully developed using this technology in the areas of livestock and animal control, vehicle access, tolls and fees, asset tracking, and airport baggage identification. As the contractor and owner pilot tests reveal, RFID can be a promising technology for enhancing construction operations related to material receiving and also possibly other operations related to maintenance and operations.

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RFID Applications for Owners and Contractors

Plenary Slides

FIAPP — Today's Reality

FIAPP Steering Team — Implementation Session Only

Learning Objectives

- Learn about the Fully Integrated and Automated Project Processes (FIAPP) vision and why you should be involved.
- Find out how we will plan to make FIAPP a reality by reviewing the FIAPP roadmap.
- Discover what's happening now.
- Learn about some of the current best practices.

Abstract

This session will explain the FIAPP vision and roadmap and the results of case studies on companies that have used FIAPP techniques. The case studies will highlight best practices learned to date. Participants will be encouraged to provide feedback on specific areas of the broad FIAPP topic that they feel should be investigated next, plus any proposed topics for new research in the FIAPP area.

Implementation Session Moderator

James V. Bartlett, Jr. – Assistant Director, Engineer Operations Center, Naval Facilities Engineering Command (NAVFAC)

Jim Bartlett is the Assistant Director, Engineer Operations Center, for the Naval Facilitites Engineering Command, in Washington, D.C. He is responsible for Client Liaison for NAVFAC — an $8 billion enterprise with subordinate organizations worldwide. He works with a wide range of customers including the Navy's Major Claimants; other Military Services; Defense Agencies; Federal Agencies; and others. From 1988-1997 he was Director, Interagency Construction Division; from 1982-1987, Director of Program Management for the TRIDENT and Strategic Homeporting construction programs. A retired Navy captain with Viet Nam experience, he worked for the Smithsonian Institution after a 30-year career with the Navy, joining NAVFAC in 1980. He holds a bachelor's degree in electrical engineering from West Virginia University and a master's in engineering administration from George Washington University.

Implementation Session Panelists

Reginald S. Gagliardo, Vice President, Engineering – Burns and Roe Enterprises, Inc.

Deborah L. Grubbe, Safety & Health Director – DuPont Safety, Health & Environment

Kent A. Reed, Leader – CIC Group, National Institute of Standards & Technology (NIST)

Anthony D. Songer, Assistant Professor – Civil, Environmental & Architectural Engineering, University of Colorado at Boulder

FIAPP — Today's Reality

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Owner/Contractor Work Structure Decision Process

Owner/Contractor Work Structure Education Team —
Implementation Session Only

Learning Objectives

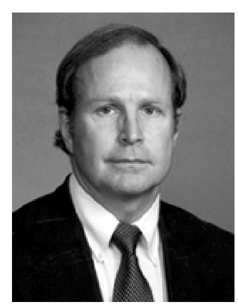
- Understand the corporate- and project-level work structure processes and applications.
- Learn about the potential benefits of the decision processes as they relate to the planning and execution of capital projects.
- Explore the potential for use of the decision process as a business analysis tool (evaluation of core competencies, including their functions and critical capabilities, and the sourcing of competencies).
- Learn how member organizations have used this process to make and record decisions about complex issues.

Abstract

Visit this session to preview the upcoming CII Education Module, *Optimizing Owner/Contractor Core Competencies for Project Success*. Owners continue to restructure their capital project organizations, and fewer are reducing the owner engineering resources available to develop and execute capital projects. As a result, owner/contractor work relationships are changing in relation to capital project development and execution. The focus of this presentation will be on the Owner/Contractor Work Structure (OCWS) process for capital projects. This presentation will thumb-nail the entire OCWS decision process, giving insight to both owners and contractors concerning the benefits of this structured decision aid process.

Implementation Session Moderator

Stuart D. Anderson – Associate Professor, Texas A&M University



Dr. Stu Anderson is on the faculty of Texas A&M University, where he teaches graduate and undergraduate courses in project management, methods improvement techniques, project development, and project cost estimating, planning, and controlling. For 13 years, he worked in the private sector with the Fluor Corporation and Stone & Webster Engineering. In 1997, he received the CII Outstanding Researcher Award for his work on the owner/contractor work structure. He holds a bachelor's degree from the University of Washington, and master's and doctorate degrees from UT Austin.

Implementation Session Panelists

R. J. Jessop, Director, Project Management Electricity Production – Ontario Power Generation

Raymond C. Wenz, Jr., Vice President/Chief Estimator – Zachry Construction Company

Tom E. Will, Director of Capital Performance Process for Polymers & Resins – Rohm and Haas Company

Owner/Contractor Work Structure Decision Process

Introduction

In 1997 the Construction Industry Institute (CII) published its *Owner/Contractor Work Structure Process Handbook*. CII developed the Owner/Contractor Work Structure (OCWS) process to assist in the determination of project competencies and in making rational decisions about the most appropriate sourcing of these competencies for capital projects. The decision process was developed for use at the corporate level to address the needs of the owner's capital program and on a project-by-project basis for single capital projects. A CII Education Module was subsequently developed to help owners and contractors implement the process.

This paper presents an overview the OCWS process and focuses on key terms, concepts, steps, and worksheets used in the decision process. A summary of the contents of the CII Education Module, Optimizing Owner/Contractor Core Competencies for Project Success, is presented next. Results from three "real world" applications of the process are summarized. A summary of benefits from implementing the process is provided in addition to general conclusions concerning the process.

Overview of the OCWS Process

The OCWS process provides a qualitative definition of the work relationship between an owner and contractor(s), depending on the extent of their individual involvement in performing a competency for a particular project or a capital program. Since the process was conceived as an owner-driven process, it was developed from the owner's perspective. The term 'contractor' was intended to imply a contractor in the traditional sense, or a designer, a supplier or an alliance partner. The term 'owner-contractor work structure' that was coined in this research is defined as 'the distribution of roles and responsibilities between the primary project participants based on key project competencies.' Competencies are defined as processes comprised of functions and associated capabilities needed to develop and execute capital projects. Thirty competencies, listed in Table 1, were developed to serve as a starting point for users of the process. During implementation of the OCWS process, project competencies are documented on a competency worksheet, and the work relationship decisions are documented on a work structure worksheet. An alignment worksheet was developed to help the owner and the contractor(s) check the alignment of their work relationships.

Table 1. Capital Project Competencies

NO.	COMPETENCY	DEFINITION
1	Alliance/Partnering	Utilizing long-term relationships with two or more organizations for the purpose of achieving business objectives.
2	Benchmarking & Metrics	Benchmarking — process of assessing and establishing standards to achieve excellence in performance; Metrics — process of measuring progress of project performance against established standards.
3	Business Development	Conversion of owner business needs into project goals.
4	Commissioning/Startup/ Performance Testing	Front-line development, management, and coordination of operations and/or contractor personnel to proceed toward and prove commercial operation.
5	Conceptual Cost Estimating	Preparation of estimates at various stages of scope development for purposes of project option selection.
6	Constructability	Incorporating construction knowledge and experience into project development and execution.
7	Construction	Installation of permanent facility equipment and materials including all support required to do so.
8	Construction Management	Management oversight of field construction operations and startup.
9	Convert Research to Project/Scale Up	Defining project requirements based on new or improved products or processes.
10	Definitive Cost Estimating	Preparation of estimates for purposes of procurement and project control.
11	Detail Design	Completion of design drawings and material and equipment specifications.
12	Environmental/Permits	Ensuring compliance with environmental laws and regulations, filing permit applications, and site assessments.
13	Field Quality Control	Conducting inspections required to achieve the specified level of quality.
14	Financial Approval	Development of appropriation requests, risk analysis for corporate strategy, and project funding approval and decision-making at owner level.
15	Legal/Contract Administration	Contract negotiation and interpretation to include change order management and dispute resolution.
16	Lessons Learned	Knowledge gained through the collection and analysis of experiences, successful or otherwise, to be applied to future projects for purpose of improving performance.
17	Maintenance & Operability	Incorporating input from maintenance & operations during project development and detail design phases.
18	Preliminary Design/ Scope Development	Conceptual preparation of overall project design and scope.
19	Process/Conceptual Design	Process definition and feasibility analysis congruent with overall project objectives, including owner proprietary process know-how.
20	Procurement	Corporate procurement buying strategy, contractual arrangements, and vendor inspections.
21	Project Controls	Identification and reporting of actual and potential cost and schedule deviations.
22	Project Management	Management and coordination of project development and execution.
23	Project Management Oversight	Leadership of owner effort of project development and execution including decision-making authority.
24	Project Planning/ Scheduling	Determination of project development and execution strategies such as contractingplan and materials management plan.
25	Risk Management	Assessment, analysis, planning, and control of risks on a project.
26	Safety	Ensuring or supporting compliance with operating facility and OSHA regulations and requirements including construction safety.
27	Setting Project Goals, Objectives, & Priorities	Establishing key project requirements and prioritizing these requirements to meet the business/developed needs for the project.
28	Team Building	A project-focused process that builds and develops shared goals, interdependence, trust and commitment and accountability among project team members.
29	Technical Expertise	Specific equipment, systems, or technological specialization.
30	Total Quality Management	Provide continuous work process improvement methodology during project development and execution.

The key terms in the OCWS process are summarized as follows:

- **Owner/Contractor Work Structure**: the strategic distribution of roles and responsibilities that are defined in terms of owner-contractor work relationships for each competency, based on key project competencies.
- **Competency**: a project work process that is comprised of functions and associated critical capabilities needed to develop and execute a capital project.
- **Functions**: activities and tasks that describe the work involved in performing a competency.
- **Critical capabilities**: the knowledge, abilities, skills and experience that are necessary to perform competency functions.
- **Core competency**: a competency that must reside with the owner and is critical to project success.
- **Non-core competency**: a competency that could either be outsourced or performed in-house, depending on the project circumstances.
- **Work relationship**: a relationship defining the extent of involvement of the owner and the contractor, in performing, leading, and/or providing input with respect to a competency.

The concept of "work relationship" in the OCWS process is based on the extent of involvement the participants have in the execution of a particular competency. In the absence of a quantitative parameter to measure the extent of involvement, the concept is best explained on a continuum that assumes 100 percent owner involvement on one end, and 100 percent contractor involvement at the other end. The term "contractor" may imply a contractor, a consultant, a supplier or another person or organization that is outside the "owner" organization. The owner-contractor work relationship continuum is shown in Figure 1.

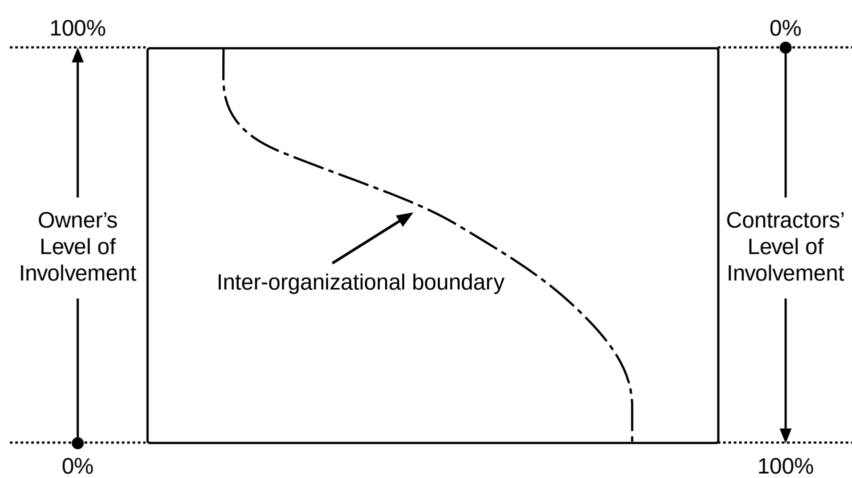


Figure 1. Owner/Contractor Work Relationship Continuum

Five types of owner-contractor work relationships are defined, to characterize the owner-contractor work relationship continuum shown in Figure 1. The five relationships are identified as OP, OP/CI, OL/CP, CP/OI and CP. These are defined as follows:

1. OP: The owner performs all work involved in the competency using their resources according to their work process.

2. OP/CI: The owner performs most functions using its work process with contractor input. The majority of work is performed using owner resources. The contractor provides input or acts as a consultant.

3. OL/CP: The owner leads function performance with contractor performing the detailed work using the owner's work process. The owner leads by setting guidelines, directing, reviewing, and approving the work. The contractor performs most of the competency work functions according to the owner's work process.

4. CP/OI: The contractor performs most functions using the contractor's work process with input from the owner. The majority of work is performed using contractor's resources.

5. CP: The contractor performs all work involved in the competency using their resources according to their work process. The owner can still supply input and guidance by performing project management oversight.

Figure 2 provides a conceptual illustration of the owner-contractor work relationship continuum for a particular competency with the five types of owner-contractor work relationships given on this continuum. The location of the inter-organizational boundary determines the type of work relationship that is most appropriate for the competency being evaluated.

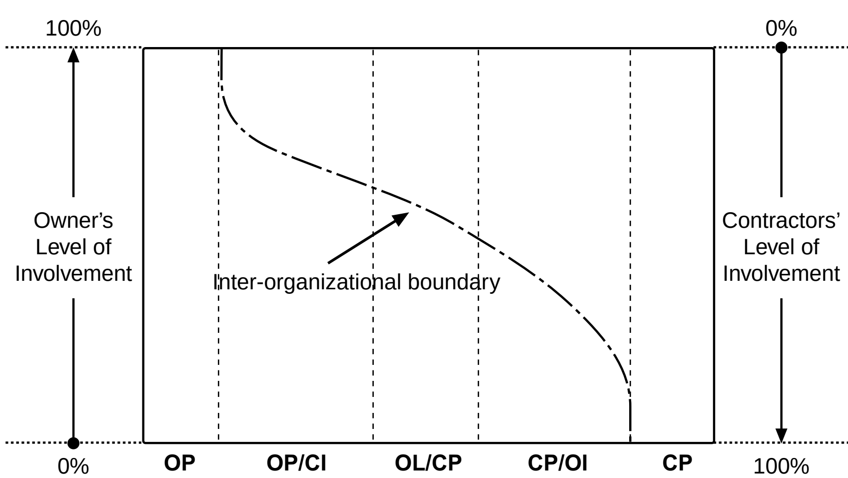


Figure 2. Owner-Contractor Work Relationships

This concept is further illustrated in Figure 3, by applying the owner-contractor work relationship continuum shown in Figures 1 and 2 to an individual competency. This diagram illustrates the true nature of the inter-organizational boundary that splits the competency into two parts. The location on the inter-organizational boundary depends on the extent of contribution of the owner and the contractor towards the execution of that particular competency.

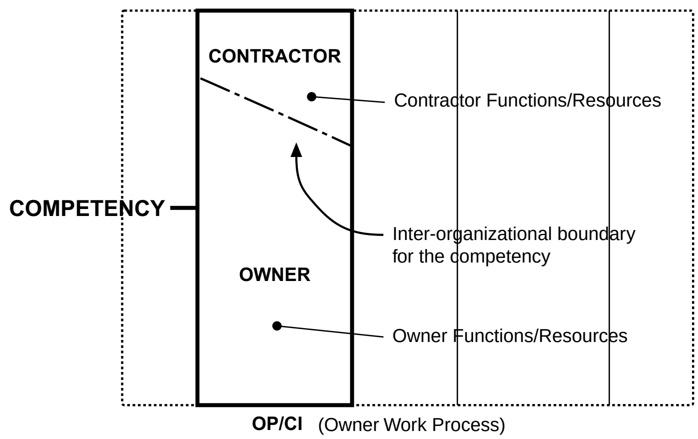


Figure 3. Owner-Contractor Work Relationships for a Competency

The steps in the OCWS process are somewhat different, depending on whether it is used as a project level process or a corporate/capital program level process. The corporate level process is shown in Figure 4.

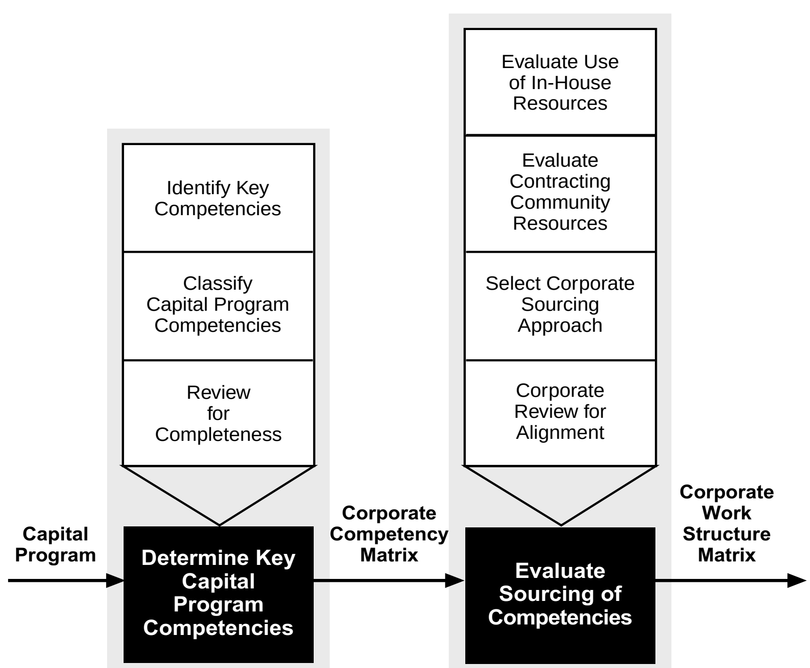


Figure 4. Owner-Contractor Work Structure Process: Corporate Approach

The project level application of the OCWS process involves an additional step of determining the work structure by project phase. The purpose of this step is to enable the owner and the contractor(s) to make changes in the work relationships during various phases of a capital project. The project level process is shown in Figure 5.

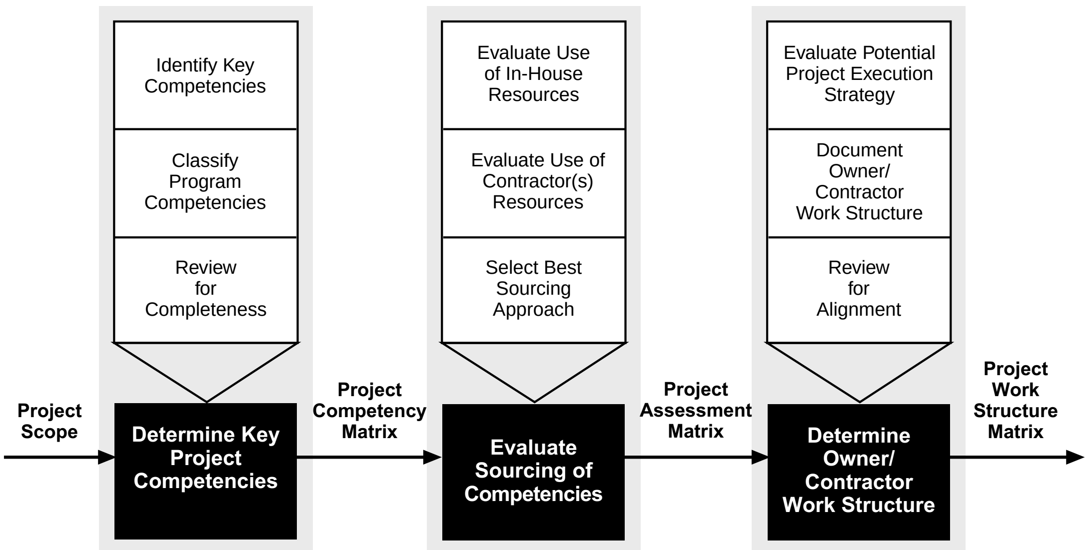


Figure 5. Owner-Contractor Work Structure Process: Project Approach

As shown in Figure 5, the output of each function is described in terms of a matrix. These matrices document decisions made when performing the process functions. For example, Figure 6, Project Competency Worksheet, documents both of the competencies needed for a project and whether or not each competency is core or non-core to the owner for the project. In the illustration shown in Figure 6, Alliance/Partnering was not required for the project. Three other competencies were considered core to the owner with Benchmarking/Metrics designated as a non-core competency.

PROJECT COMPETENCY WORKSHEET

COMPETENCY	NOT REQUIRED ON THIS PROJECT	CORE COMPETENCY	NON-CORE COMPETENCY
Alliances/Partnering: Utilizing long-term relationships with two or more organizations for the purpose of achieving business objectives.	✓		
Benchmarking/Metrics: Benchmarking-Process of assessing and establishing standards to achieve excellence in performance; Metrics Process of measuring progress of project performance against established standards.			✓
Business Development: Conversion of Owner business needs into project goals.		✓	
Commissioning/Start-Up/ Performance Testing: Front-line development, management and coordination of operations and/or contractor personnel to proceed toward and prove commercial operation.		✓	
Conceptual Cost Estimating: Preparation of estimates at various stages of scope development for purposes of project option selection.		✓	

Figure 6. Example of a Project Competency Worksheet

The second matrix, the Project Assignment Worksheet in Figure 7, documents decision made on the work relationship assigned to each project competency. As illustrated in this figure, a variety of work relationships can be used. Business Development is owner performed (OP). Conceptual Cost Estimating is owner performed but contractor input is required (OP/CI). In the case of Commissioning/Startup and Performance Testing the owner will lead the competency and the contractor will perform the functions of this competency using the owners work process (OL/CP). For the non-core competency, Benchmarking/Metrics, an outside consultant will perform the competency functions supported by input from the owner (CP/OI).

PROJECT ASSIGNMENT WORKSHEET

COMPETENCY	OP	OP/CI	OL/CP	CP/OI	CP
Alliances/Partnering	–	–	–	–	–
Benchmarking/Metrics				✓	
Business Development	✓				
Commissioning/Start Up/Performance Testing			✓		
Conceptual Cost Estimating		✓			

Figure 7. Example of a Project Assignment Worksheet

The third matrix, Project Work Structure Worksheet in Figure 8, documents the project phase(s) in which the competency is most likely performed. This worksheet illustrates a key feature of the OCWS process. Notice that the Conceptual Cost Estimating competency is initially owner performed with contractor input (OP/CI) as shown during the concept development phase of the project. Once preliminary design begins the owner will lead this competency and a contractor will perform the competency functions (OL/CP).

PROJECT WORK STRUCTURE WORKSHEET

COMPETENCY	Define Bus. Needs	Develop Concept	Prelim. Design	Detail Design	Procure Equipment & Materials	Construct Design	Start-Up
Alliances/Partnering							
Benchmarking/Metrics		CP/OI	CP/OI				
Business Development	OP	OP					
Commissioning/Start Up/Performance Testing						OL/CP	OL/CP
Conceptual Cost Estimating		OP/CI	OL/CP				

Figure 8. Example of a Project Work Structure Worksheet

The typical OCWS process does not rely on objective characteristics of projects. Instead, it relies extensively on the perceptions of organizational decision makers for identifying the competencies of firms, determining whether the competencies are best performed in-house or by contractors, and evaluating whether the work structure chosen is effective (Gibson, Davis-Blake, Broschak, & Rodriguez, 1998).

Overview of an Education Module

A brief overview of the contents of the education module is discussed in this section. The course learning objectives are presented first. Next, a short description of the course is presented by session. A typical course agenda with times is provided to indicate the time allocated to each session, including the basic content covered in the session.

Course Objectives for Instructor

The following are objectives that the instructor should attempt to achieve:

1. Develop an understanding of the corporate and project level work structure processes.
2. Assist the participants in how to apply the project level work structure process.
3. Help the participants understand potential benefits of the processes, as they relate to the planning and execution of capital projects.
4. Encourage the necessity for candor and honesty in core competency analysis.
5. Provide an understanding of the potential to use the work process as a business analysis tool (evaluation of core competencies, including their functions and critical capabilities, and the sourcing of competencies).
6. Promote the implementation of the process within participant organizations.

Course Description

The course is comprised of seven sessions. The instructor is provided with objectives that should be accomplished for an individual session. A comprehensive case study is used to provide participants with an opportunity to apply the OCWS process to a project. Sufficient time is allowed for discussion in each module, including case study results.

Introduction — Session 1

This session reviews trends in owner/contractor relationships based on both previous and current research. Questions are posed for owners and contractors to consider in how to manage changing owner/contractor work relationships. The session ends with an overview of the module, course objectives, and an agenda for all remaining sessions.

Owner/Contractor Work Structure Process: Overview — Session 2

This session defines key terms that form the basis for the Owner/Contractor Work Structure process. Example applications of these terms are presented, in addition to a list of 30 project competencies. A summary level discussion of the Corporate and Project level work structure processes is provided.

Determine Key Project Competencies — Session 3

This session familiarizes the participants with the first function of the OCWS project level process (see Figure 5). Sub-functions are discussed as well as key information needed to perform these sub-functions. Key project participants who should perform these sub-functions are identified. Factors that determine whether a competency is core or non-core to the owner are discussed. Worksheets are used to document decisions made to Determine Key Project Competencies (see Figure 6). The session is concluded with Part I of the World Wide Chemicals Case Study.

Evaluate Sourcing of Competencies — Session 4

This session familiarizes the participants with the second function of the OCWS process (see Figure 5). Sub-functions are discussed as well as key information needed to perform these sub-functions. Key project participants who should perform these sub-functions are identified. Factors that determine the work relationship assigned for a competency are discussed. Worksheets are used to document decisions made to Evaluate Sourcing of Competencies (see Figure 7). The session is concluded with Part II of the World Wide Chemicals Case Study.

Determine Owner/Contractor Work Structure (by Project Phase) — Session 5

This session familiarizes the participants with the third function of the OCWS process (see Figure 5). Sub-functions are briefly discussed. Factors that may change a work relationship during project development and execution are discussed. Worksheets are used to document decisions made to the Determine Owner/Contractor Work Structure (see Figure 8). An overview of tools that can be used to periodically check for work structure alignment is presented. The session concludes with Part III of the World Wide Chemicals Case Study.

Applying Owner/Contractor Work Structure Process — Session 6

This session presents and discusses possible alternate applications of the O/CWS process with emphasis on the generic nature of the process. Other CII best practices that can incorporate the O/CWS process are presented. Potential benefits of applying the process are discussed.

Wrap-up, Conclusions, and Evaluation — Session 7

This session reviews the application of the O/CWS process and why the process can be a useful tool for identifying project competencies and the sourcing of these competencies to help owners and contractors achieve strategic alignment of work relationships.

Course Agenda

A typical agenda for an eight-hour training module is provided below:

Generic Agenda: Eight-Hour Schedule

1.	Introduction - Review Current Trends - Agenda - Overview of Module - Objectives of Course	8:00-8:30
2.	Owner/Contractor Work Structure Process: Overview - Define Key Terms - Provide Examples - Preview Processes	8:30-9:30
	Break	9:30-9:45
3.	Determine Key Project Competencies - Review Details of Process - Introduce Case Study - Conduct Case Study	9:45-11:45
	Lunch	12:00-1:00
4.	Evaluate Sourcing of Competencies - Review Details of Process - Introduce Case Study - Conduct Case Study	1:00-2:50
	Break	2:50-3:00
5.	Determine Owner/Contractor Work Structure - Review Details of Process - Introduce Case Study - Conduct Case Study	3:00-4:00
6.	Issues in Applying Owner/Contractor Work Structure Process - Suggest Other Applications - Suggest Use with Other CII Best Practices - Discuss Benefits	4:00-4:30
7.	Wrap-Up, Conclusions, and Evaluation	4:30-4:50

Process Applications

CII and the Alfred P. Sloan Foundation jointly funded follow-up research with the objective of testing, validating, and improving the Owner/Contractor Work Structure process. Due to subjectivity inherent in an assessment of owner-contractor work relationships with the help of the OCWS process, the nature of the follow-up research was qualitative. Also, given the limited existing knowledge base on the determination of owner-contractor work structures, investigations in this area were exploratory in nature, making it difficult to construct hypotheses based on quantifiable parameters. Therefore, the research methodology relied on an owner survey, case studies, and the delphi method. Three research phases were followed.

Owner Survey

Phase I of the research covered a survey of owner companies in North America, the formulation of a research methodology, and the development and testing of instruments, and proposals for the case studies that followed in Phase II. As part of Phase I of the research, owner companies were contacted in the summer of 1998 to study the use of the owner-contractor work structure process developed by the CII. The results of this survey established the premise for subsequent phases of CII/Sloan research (Anderson, Patil, and Gibson, 2000). Out of the total of 62 owner companies contacted, 23 responded to the survey. Of the 23 companies, only three had used the OCWS process and 11 had reviewed the process but not used it. The remaining nine owner companies had not reviewed the OCWS process even though they had acquired a copy of the publication from CII.

Case Studies

The case studies in Phase II involved a combination of interviews and process applications for gathering data. To initiate the case studies, company-specific proposals were developed with the objective of addressing each company’s particular problem through the implementation of the OCWS process. Two CII owner companies in North America accepted the proposal to implement the OCWS process. OCWS process implementation with one company involved the development of a new proposed alliance with a large contractor. In this case, the owner was a large refining company. The second implementation effort involved restructuring of the owner company’s capital projects’ organization based on a business model approved by top management. In this case, the owner was a large power company. A third CII company agreed to participate in an interview to evaluate a recent application of the process for developing an owner-contractor work structure for an overseas chemical plant project. A summary of the findings from these case studies is summarized below:

1. The process provides a useful mechanism for generating discussions on strategic classification of capital project competencies as core and non-core, and for determining the most appropriate sourcing strategy and work relationship for each competency.
2. In order to increase the effectiveness of process implementation, it is important to define and document the “Input” and “Lead” roles in terms of functions and capabilities required of the organization that provides input or lead responsibility.
3. The process works very well for creating a common language based on project competencies, functions and critical capabilities. Therefore, it provides an excellent tool for communication when the project participants come from diverse backgrounds and their understanding of project development and execution process differs significantly.
4. The process is particularly suitable for assisting management when structuring a capital projects organization, since it helps decision-makers conduct a review of the organization’s competencies and align them with the strategic objectives of the company and the business units.
5. The process provides a mechanism for assessing alignment within the owner organization, and also between the owner and other stakeholders.
6. The effort required for successful implementation of the process varies depending on the expectations of the user from each implementation.
7. Implementing the OCWS process involves continuous resolution of differences between members of the implementation team, and alignment with strategic directives of the top management. Therefore, facilitation by an unbiased facilitator who is thoroughly knowledgeable about the implementing organization can greatly enhance the effectiveness of the effort.

A comprehensive report covering the case studies is published by the Center for Construction Industry Studies at the University of Texas at Austin (Anderson, Patil, and Gibson, 2000).

Delphi Validation

The delphi method was used in Phase III of the CII/Sloan research for validating the OCWS process. It involved an iterative assessment of the OCWS process by professionals from industry, facilitated by controlled feedback. Forty-seven professionals representing thirty-two owner companies and two consulting companies participated in the delphi validation. The research highlighted several important issues and validated the steps and the tools used in the OCWS process. Overall, the participants agreed that the OCWS process is a valuable approach for developing optimal owner-contractor work relationships, and that the process complements existing project management tools and best practices.

The participants provided important insight into policy implications based on findings of this research. One recommended policy is that the OCWS process should be incorporated into capital project procedures typically adopted by a company, to realize the benefits of implementing the process. A second recommended policy is that implementing the corporate work structure provides a strategic basis for owner-contractor work relationship decisions for individual capital projects.

An important finding of the delphi study was that professionals with executive management experience and those without such experience had different perspectives on the usefulness of the OCWS process, and the utility of the process for structuring alliances. Individuals with execute management experience also appeared to have better understood the conceptual framework of the OCWS process, as compared to those without any executive management experience. Another important finding was that statistical comparison of average responses was the same for individuals familiar with the OCWS process prior to conducting this study and those that were not familiar with the process prior to the study.

A third questionnaire asked the participants specific questions on implementation of the process with respect to their organizations. The questionnaire also asked the participants about what they considered to be the potential benefits of the process, and potential improvements. Of the 47 participants from Round 1, 32 individuals completed and returned the questionnaire. Although this was a substantial reduction in the number of participants, it was not a reason for concern since the third round did not have a bearing on the validation of the OCWS process. The key findings of the survey were as follows:

- Twenty-three respondents said that they intended to use the OCWS process.
- Nineteen respondents said they would use the Project process while only seven respondents said they would use the Corporate process.
- Estimates of effort required to implement the OCWS process varied substantially, suggesting that the respondents were likely to have different objectives that they expected to achieve from the process.
- Many of the respondents said they intended to use parts of the process.

The estimates of workdays of effort that would be required to implement the OCWS process are summarized in Table 2. In order to establish a reasonable range of estimates for implementing the corporate process, estimates in the top and bottom 10 percent of the estimate range were treated as outliers, and hence, dropped from the descriptive statistics.

Table 2. Estimates for Implementing the OCWS Process

		All* Participants (N=29)		Participants Familiar with OCWS Process (N=19)		Participants Not Familiar with OCWS Process (N=10)	
		μ	σ	μ	σ	μ	σ
Estimated Number of Man-days Required to Implement the OCWS Process	Corporate Process	61	60	138	45	34	33
	Project Process	13	11	14	11	13	11

* Three Participants Did Not Provide the Estimates

The data indicate that estimates for implementing the corporate process, provided by participants familiar with the OCWS process, are significantly more than the ones provided by participants not familiar with the process. However, the estimates for implementing the project process are nearly the same. One possible explanation for the difference in implementing the corporate process is that those not familiar with the process are likely to underestimate the effort. The shorter time required to implement the project process may be because the corporate process is implemented prior to using the process for a project. Therefore, the corporate work structure serves as a strategic guideline for developing the project work structure.

Effective application of the OCWS process mandates that the process is first implemented at the corporate or the capital program level. The corporate work structure is then used as strategic policy input, while implementing the process for a specific project. However, the majority of the participants responded by saying that they would only use the project process. One reason behind this response could have been that the importance of using the corporate process before the project process was not adequately explained to the participants at the beginning of Round 1. However, out of the 20 participants who were familiar with the process, 18 said they would use the project process. Of these, only 4 participants said they would use the corporate process. Although the sample size is very small and the term ‘familiarity’ may not be well defined, it is interesting to note that 78 percent of the individuals familiar with the OCWS process said they would use only the project process.

Expected benefits of the OCWS process that were identified by the respondents are as follows:

- The OCWS process would promote integrated teams and awareness of core competency assignments.
- The process would facilitate better understanding of owner/contractor roles and responsibilities. The process could also help in the development of Engineering Alliances, wherein there are major cultural changes needed on both sides of the fence.

- The process would lead to better-organized projects, assuring all areas of need are being provided for in the most efficient manner.
- The OCWS process seeks to develop consensus across locations on what competencies are required for projects and if they will be provided internally or through contractors.
- The process would contribute to increased productivity with limited owner staffing, and better decisions on renewal and resource levels for owner staff.
- The process provides a clear and efficient approach for determining degree of owner-contractor resources and processes for individual projects.
- The process would result in reduced manning needs when considering both company and contractor employees combined.
- The OCWS process would eliminate most of the “gray” areas between the owner and the contractor/major suppliers on key issues.
- The process could lead to improved project definition, and better ability to manage conflict and change.
- The process would facilitate clearer understanding of which functions are critical to owners.
- The process would improve discipline through the communications process.
- The process can be used to ensure consistency in the approach to work.
- The process could enhance the user organization’s competitive advantage.

A comprehensive report covering the Delphi validation is published by the Center for Construction Industry Studies at the University of Texas at Austin (Anderson, Patil, and Gibson, 2000).

Benefits of Process

The benefits expected from implementing the OCWS process are summarized below. The benefits, as initially suggested in the original research, were confirmed by industry applications. Further, the education team involved in developing the module also confirmed that the stated benefits of the process are effectively demonstrated through the use of the education module. Key benefits are summarized below:

- Systematic approach to determine key project competencies and their sourcing
- Vehicle for documenting decisions related to competency evaluation and sourcing.
- Vehicle for discussion when different viewpoints are represented
- Rationale for evaluating project skills and resources needed

- Leads to efficient operations by avoiding gaps and eliminating overlaps through alignment of work structures
- Flexible and can be used in different situations by different companies
- Easy to use but can take considerable effort
- Instrument for rational organizational change
- Can be a source of improved capital project effectiveness
- Can help achieve project success

Conclusions

The following general conclusions concerning the OCWS process are:

- Process does work!
- Process can be tailored to meet requirements of application.
- Process is very flexible.
- Process achieves benefits stated in education module.

Education Module 111-21, *Optimizing Owner/Contractor Core Competencies for Project Success*, can help with implementation of the OCWS process.

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Center for Construction Industry Studies Web Site:

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Beyond e-Commerce:
25 Other Opportunities for Construction
Keynote Speech: John G. Voeller

Abstract

Starting with the PC, technology has created a series of parallel events we all have had to consider. One track is the fads and failures and these get the bulk of the attention. The other track is the substantial technology that endures and brings value and is often times clouded by the furor of the next big fad. This presentation will concentrate on the next several dozen pieces of this second track we will encounter in the next four years. For example:

1. Wireless broadband
2. Proactive computers
3. Intelligent devices
4. Self-repairing systems
5. Keyboardless computing
6. Searching without search engines
7. Machine-based e-commerce
8. Multi-physics sensors
9. AL-based control systems
10. Zero-effort productivity reporting
11. Boltless steel
12. Six-access automated rebar fabrication
13. Integrated excavation
14. Materials self-management
15. Organic bead microbiotic trench remediation
16. Intelligent transportation self-funding strategies
17. Life-cycle middleware framework
18. Zero-purchase procurement
19. National construction knowledge network
20. Gypsy craft webification
21. The disciplineless engineer
22. Decision-centric computing
23. Femto-second recognition systems
24. Location-independent achievement
25. Convergence and complexity

Keynote Speaker

John Voeller reports directly to the CEO of Black & Veatch and has absolute responsibility for all information technology decisions. He is a member of the Executive Committee and the Operations Committee and chairs the Process Architects Council that manages all IT direction for the business units. Unlike other firms, his CEO sought to combine the CTO and CIO role under one umbrella using the CKO moniker to emphasize user ownership of information and IT success.

Mr. Voeller is responsible for the creation of five- and ten-year automation strategies. He is the principal architect of POWRTRAK, the automated engineering system of Black & Veatch that fueled its movement from thirteenth to first in the U.S. and the world in power plant design and delivery. This unique system has been reviewed in articles in *ENR*, *Forbes ASAP*, and *CIO*.

He has been president of PlantSTEP, a consortium focused on creating data exchange standards for the process and power industry. He also advises the PIEBASE global consortium, and is CEO and President of Data Discovery, Inc. which sells his recursive search technology.

Mr. Voeller received *ENR*’s Award of Excellence for 1998. The award is *ENR*’s highest honor for most significant individual achievement in the construction industry.

e-Business and the Changing Face of the Construction Industry

Case Study: Primavera Systems

Learning Objectives

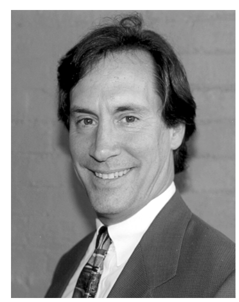
- Discover how the introduction and use of e-business and web-based tools can impact the entire facility life cycle, from pre-project planning through design and construction to long-term facility management.
- Learn how to prepare your company for the transition to e-business.
- Improve your ability to evaluate potential technology providers.
- See how to reduce the total life-cycle costs of facility ownership through the use of e-business.

Abstract

The presentation will give an overview of e-business for design, construction, and life-cycle facility management, recommend specific actions to prepare your company for e-business, and provide key questions to ask when evaluating potential technology providers.

Plenary Session Presenter

Steven Jones – Vice President of Business Development, PrimeContract.com.



Steve Jones is Vice President of Business Development for PrimeContract.com, a business unit of Primavera Systems, Inc. in Bala Cynwyd, Pennsylvania. His company provides e-business solutions for the construction industry. He has over 25 years of experience in the architecture, engineering, and construction industries. Before joining Primavera, Steve was a Principal and a Board of Directors member with Burt Hill Kosar Rittleman Associates, one of the nation’s largest A/E firms. He holds an undergraduate degree from Johns Hopkins University and an MBA from the Wharton School of the University of Pennsylvania.

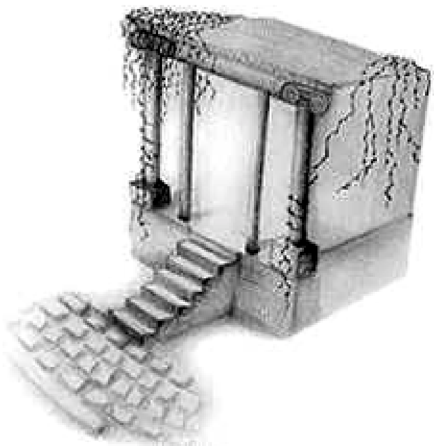
Implementation Session Moderator

Steven Jones, Vice President, Business Development – Primavera Systems, Inc.

Implementation Session Panelist

Paul Doherty, Principal – the digit group

e-Business and the Changing Face of the Construction Industry



HOW FAST ARE YOUR PROJECTS?

HOW FAST ARE YOUR BUILDINGS?

HOW FAST IS YOUR COMPANY?

How companies respond to these questions will determine winners and losers in the emerging e-Business world. Welcome to the New Economy, where the rapidly escalating convergence of clicks and mortar is creating many new ways of doing business ... every day. And you cannot run a business for this online world, offline. If you are not at least thinking about how e-Business affects your company, you will be at a competitive disadvantage.

The New Economy

Just delivering buildings on-time and within budget is no longer enough. The construction industry of the New Economy is not about just doing the same old things faster. It's about seeing new ways for technology tools to change your business; realizing that computers are not for computing, they are for communicating. Tools like e-mail and the Web have shifted the focus of technology from number-crunching to information management.

The new challenge is to create valuable information, then apply your expertise to provide it in comprehensible, accessible packages of knowledge for others to use, so they have precisely what they need, exactly when they need it. This creates not just information resources, but knowledge models that can connect into a growing system from which we all can learn. By investing in these knowledge models, a business can better understand the impact of its decisions and become a continual learning organization. This requires a larger emphasis on post-mortem project meetings, sales analysis and customer feedback, creating a dynamic system of knowledge management and best practices.

The New Economy demands that you look beyond traditional supply chains and familiar project delivery processes to create new, digitally interconnected paths among your suppliers, vendors, installers, consultants and customers. The increasing need for a project information supply chain that operates at Internet speed is driving the construction industry's experimentation with innovative technologies like project extranets and online procurement.

Before there was a New Economy, slowness and fragmentation protected market segments. But increasingly, the difference between those who use the speed and power of new technology and those who don't is not merely incremental. It is fast becoming a quantum leap. This new power of speed and interconnectivity collapses the traditional market segments, the discrete pockets of expertise and the separate silos of information that we are familiar with. It challenges us to find where we fit in as new market segments and new professions are created in unpredictable ways, and old roles and business models are rendered irrelevant. If you don't make this leap to digital speed, your business will end up with a customer base that will spend the least, and cost you more to serve.

Getting Started

Interconnecting your company into global information and product markets through Web-based e-business tools is a beginning step to understanding the changing role you and your business will play. You will be able to see first hand the efficiencies created by:

- Giving project team members in every part of the information supply chain access to key information from anywhere, at any time.
- Making well-informed, multi-party decisions more quickly.
- Communicating to the rest of the team in real time.
- Automatically archiving all activity into a permanent, digital project record

The rapidly emerging AEC Dot Com industry (US $2.3 Billion as of July 2000, according to a joint study of the digit group and the GartnerGroup) is designing, building and providing those Web-based tools. In all there have been nearly 250 companies that have announced plans to enter the e-business market for AEC in some form.

In most cases these are being designed as "hosted solutions," meaning that your project data and most of the functionality of the software both reside offsite in servers maintained by the Dot Com. The Dot Com acts as an ASP (Application Service Provider), selling you the use of that functionality and the access to your stored data over the Internet on an as-you-go basis. This is a fundamental change from the traditional business model of having to buy, install and maintain software on your own computers. The ASP will keep the software up to date, and all you need is a standard web browser to use it. Your company can now try a number of providers in this ASP approach without having to invest in software or commit to standardizing at this point in the development of the market.

The downside of trying several providers is time. There are no standards yet, so each system has its own workflow, business rules and organization, and it will take time for your staff to learn how to use each system and comparatively evaluate them. Also, many of the Dot Com's are start-ups that were funded sometime in 1999 by venture capitalists hoping to take them public within 12 months. That now being unlikely, some will not receive further funding and will be unable to continue operations. You don't want to be working with one of those when their time runs out. Looking at the stability of the organization behind the website may be more important than looking at the functionality when deciding whom to try.

Dot Com Functionality

Of the Dot Com functions available today the most common tool is an externally-hosted, subscription-based project extranet website. An extranet website provides a controlled-access place on the Web where project documents can be stored, updated, viewed or downloaded, and where multiple parties can make comments and propose revisions. Extranet providers include I-scraper (*http://www.iscraper.com*), Collaborative Structures (*http://www.costructures.com*), Buzzsaw (*http://www.buzzsaw.com*), Bidcom (*http://www.bidcom.com*), BuildNet (*http://www.buildnet.com*) and Cephren (*http://www.cephren.com*).

A less-common but growing tool is the B2B (Business-to-Business) e-Marketplace, enabling online bidding and purchasing of specified products, materials and services. These are typically run on an "e-commerce engine" provided by one of several specialist companies such as i2 (*http://www.i2.com*), PurchasePro (*http://www.purchasepro.com*), Ariba (*http://www.ariba.com*), and CommerceOne (*http://www.commerceone.com*). These companies are "tool makers," providing e-commerce engines for many industries. As a result they are not tailored to design and construction, and require an intermediary company to develop workflow and business rules that apply to AEC. The development of fully functional e-Marketplaces for AEC is still in its early stages. Companies with some current functionality include Contractor Hub (*http://www.contractorhub.com*), Red Ladder (*http://www.redladder.com*), and BuildPoint (*http://www.buildpoint.com*). Several extranet companies are working on creating e-Marketplaces, and vice versa.

Other companies are developing end-to-end solutions which include both extranet and e-Marketplace functions, plus a wide range of other related features and capabilities to support the entire facility process, from pre-project planning, financing and team assembly, through design, construction and project management, to ongoing facility management, maintenance and operations. They are intended as broadly based e-Business platforms for owners and builders of major facility programs worldwide. These include PrimeContract.com (*http://www.primecontract.com*), Meridian Project Systems (*http://www.mps.com*), and Bricsnet.com (*http://www.bricsnet.com*).

At the other end of the spectrum, some firms are specializing in narrow functionalities to serve specific e-business needs such as permitting, subcontractor lists, project management, equipment sales and rental, estimating, product catalogs, etc.

There is no shortage of e-business sites to evaluate and web-based functions to try. As with any business decision, evaluate your company's needs first, then match them to the suppliers in the marketplace.

The Role of CAD

CAD has been around for decades but today it is evolving at an unprecedented pace to meet the demands and fulfill the promise of e-business and the Internet. CAD should no longer be thought of as a "drafting tool for designers." New companies, like Web-based Revit Technology (*http://www.revit.com*) are leading the revolution in Object Oriented CAD (OO CAD), allowing designers to create 3D visual containers where data items such as manufacturer information (specifications, cost, bills of lading, etc.) can reside directly in a CAD file along with graphic information. These visual containers, known as Parametric Object Oriented Models, allow designers to leverage the value of all of the interconnecting data about a facility in smarter, unique ways. Beyond just creating a 3D experience of moving through a virtual space, "OO CAD" is providing designers the opportunity to imbed product and systems information into a life-cycle management model for the facility (such as having glass energy values seamlessly linked into energy management systems).

Wireless

But the biggest breakthrough of eBusiness in the construction industry is the world of wireless technology. The emergence and popularity of handheld devices like Palm® Connected Organizers have many AEC businesses running to understand how they can best serve their people in the field, where our industry's projects are done. Known as Portable Digital Assistants (PDA's), these powerful remote devices are allowing traditional processes like Punch Listing and Field Reports to happen in the field in the palm of your hand. PDA's, like Palm, Inc's Palm line, can also leverage Internet technologies that allow people in the field to access, view and transmit AEC information to centralized project databases through wireless technology. Palm's can now allow the extension of your web browser by accessing your project extranet in the field.

Palm

The Palm family of PDA's continue to grow daily as user demands are driving this little device from being just a scheduler/contact manager/expense reporter into a two-way communications device where you can send and receive e-mail, browse the Web, populate databases, use as a pager, use as a cell phone and as a way to exchange business card information from one Palm device to another, instead of exchanging physical business cards! The smart thing to do is to periodically check the Palm Web site (*http://www.palm.com*) for these rapid announcements and software download information.

The Palm lineup includes Palm III, Palm V, and the Palm VII. Each line has upgrade models that upgrade memory capacity. The Palm VII line uses wireless technology that provides immediate access to the Internet. Using Infrared (IR) technology, the Palm units give the user unparalleled flexibility to:

- *Print-On-Demand (POD) from the field* — by creating a quick 'napkin sketch' in the field, an architect can point their Palm to any printing device that accepts IR transmissions and print the 'napkin' instantly.
- *Transfer information from one Palm to another Palm* — the ability to point your Palm to another and exchange information on-the-fly provides the ultimate in information
- *Transmit information from a Palm to a central database or Extranet* — A contractor can transmit/submit Punch List information, Requests For Information, check the status of a Shop Drawing or send in their Field Reports by pointing their Palm to an IR-compatible device that is connected to a LAN, WAN, Intranet or Extranet. This, in turn, will populate a database, publish the report online and even send an e-mail to the team members that need to be notified.

AEC Tools

Currently, there are few AEC specific solutions made for the Palm, but emerging products are beginning to enter the market. A few of the AEC Palm products and services that are available today are as follows:

PunchList

StrataSystems (*http://www.stratasystems.com*) has a savvy product AEC focused Palm product called PunchList®, developed for the architect, engineer or contractor in the field. This software will allow you to keep track of punch list items, personnel and send fax and e-mail transmissions to project team members.

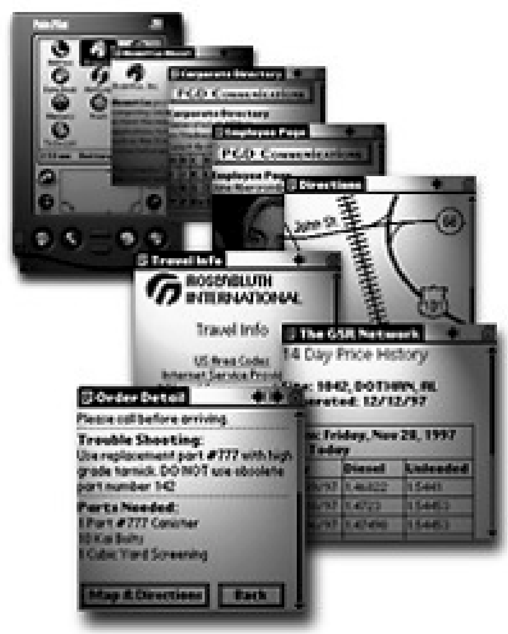
You use Punch List to collect information on your projects all day long and then synchronize with a PC in the office at the end of the day or point to an IR device. Within minutes all your contacts receive faxes listing all you need them to know about your projects. The Punch List system allows for information to be collected where it happens — in the field. Then it makes the information available where it's needed — at the contact's office, in your office, or in the field.

Written specifically for the AEC market, StrataSystems has developed a superior tool for our industry that leverages and converges project management processes with digital technologies. There is no other tool available today that performs the way PunchList does in the field.

Palm for the Web

AvantGo® (*http://www.avantgo.com*) is a Silicon Valley start up that has cornered the market in software that transforms your Palm device into a "portable Web browser." With a Palm device, small enough to take out of a shirt pocket, critical information is now just two pen clicks away — no fumbling to launch applications with a laptop and no shuffling through stacks of paper. With AvantGo software loaded on your Palm, critical information can be synchronized from the intranet or Internet directly into the hands of mobile AEC professionals who can use it — anytime, anywhere — for maximum impact and value.

AvantGo



AvantGo software allows Web pages to be copied, called Cached, onto your Palm device for surfing remotely. This means that you can download your project Web site Extranet onto your Palm for viewing in the field. For those that wish to have real-time access to the project Web site Extranet, you can purchase a modem for your Palm that will provide superior access to your project information. The ability to not just view and print information off your Palm device, but to input data through Java forms that will populate a database has emerged with an AvantGo product called Enterprise Solution.

This software comes with Server software in addition to the client software for the Palm device. By allowing the Palm to act as a data capturing device, the server software grabs and routes this information into the proper area of your intranet, extranet, LAN or WAN. This means that you can have real-time input and communication of Project Information from your Palm in the field.

Palm Printing

Hewlett Packard announced in November 1999 the availability of JetSend®, a device protocol for Palm and Windows CE handheld devices. JetSend is a protocol that will allow device-to-device communication, such as printing information from a Palm device to a HP printer in the field. JetSend sits on top of the communication layer, so devices can talk to each other by several methods, including TCP/IP, infrared or Bluetooth. The possibilities of having all remote devices on a construction project, like cell phones, beepers, printers, laptops, digital cameras or Palm's all talking the same language and communicating digital information in real time has staggering consequences on how we work on a job site. For more information, visit JetSend at *http://www.jetsend.com*.

Palm CAD

OnSite CAD software, a product by Autodesk® (*http://www.autodesk.com*) is based on the Oracle8i Lite database for Palm devices and allows workers to hook into back-end databases to retrieve plans, maps and other data. The Kansas City headquarters of Sprint was one of the beta testers, where they used Autodesk-generated GIS information on a Palm. Autodesk developed the process in which a server-side application will simplify the data before it is sent out to a Palm unit.

Palm Standards

PDA communication standards are being defined by three major initiatives, HDML (Handheld Markup Language), WAP (Web Application Protocol) and WML (Wireless Markup Language). HDML is the more proprietary, but available, standard developed by Phone.com. A consortium of vendors is developing WML. These standards promise to deliver Web-based information to Palm units, without having to re-write the content from HMTL. This automatic, server-side process will allow the rapid deployment of Web-based applications and information, since the host only has to write the code once, while being distributed on many different platforms. Major player such as Nokia, 3Com, Spyglass, AvantGo, and OmniSky (formerly OpenSky) have announced plans to adopt the WML standard.

Palm for e-Commerce

PayPal.com is a service from Confinity (*http://www.paypal.com*) that allows Palm users to beam money one another with their Palms or send money via e-mail from their Palms. It works by having users set up an account by registering on the PayPal Web site where you also download free software onto your Palm.

Whenever a payment needs to be made, either from your PayPal account or from a credit card, you input the amount you wish to pay into the PayPal application on your Palm. You then tap the Pay button and point your Palm to a recipient's PayPal-enabled Palm via infrared. The completed monetary transaction occurs when the recipient's Palm later synchronizes, connecting to the PayPal.com server and directs PayPal to deposit the money directly into a bank account, send a check or place it into a PayPal account.

Funded by Nokia, PayPal was first seen in service during the initial investment press conference when a Nokia representative beamed the first $3 million investment to the Palm of Confinity's CEO.

Emerging Ideas for Palm Technology

The Palm Operating System (OS) is being licensed to other hardware vendors beyond Palm, Inc. This has allowed hardware competitors such as Handspring (*http://www.handspring.com*) to bring the Visor to market.

Developed by the original designers of the PalmPilot, the Handspring Visor enables users to purchase "Springboards," application board add-ons that clip to the back of a Visor. This modularity provides unlimited flexibility and customization of how your Palm device works for you.

Springboards in development include: Mobile Video Conferencing; Smart TV Channel Changer; and Security Certificates for e-Commerce. Starting at $149, the Handspring Visor is emerging as a contender to cut into Palm Computing's 83% marketshare of PDA devices (IDC, June 2000).

Other emerging trends include the announcement from Palm that the next version of the Palm OS (3.5) will support color, making the Palm even more accessible for users.

Other announcements have included that Nokia, the cell phone manufacturer, has licensed the Palm OS for their cell phones to compete against another manufacturer of Palm phones, Qualcomm, whose Palm-enabled PdQ has had limited success since its release in mid-1999.

The Palm Computing Platform is providing opportunities for AEC industry users to access and manipulate data in a fast and accurate manner, lessening the chance of mistakes, especially in the field. The ability of a Palm to give easy and inexpensive mobility to our information is enabling us to think differently and is providing relevant information at the right time in the field to the decision makers who need it.

For Further Information:

http://www.primavera.com | *http://www.cyberplaces.com* | *http://www.thedigitgroup.com*

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e-Business and the Changing Face of the Construction Industry

Plenary Slides

Taking Project Performance to the Next Level
Implementation Strategy Committee

Learning Objectives

- Take advantage of the implementation support services available from CII to assist in putting CII practices to work in your organization.
- Realize the direct project benefits achieved by member organizations that support and utilize active CII Implementation Champions (ICs).
- See CII Benchmarking data that indicate organizations with active Implementation Champions produce better results.

Abstract

Currently 51 CII member organizations have appointed Implementation Champions. Since the IC provides a focal point to inspire and support the use of CII practices, organizations with ICs tend to have higher practice use, and in turn, enhanced project performance. IC Workshops, which are held two times a year, and an Internet support tool provide networking opportunities for ICs to share information and lessons learned to transcend implementation barriers.

Plenary Session Presenter

R. J. Jessop – Director of Project Management, Electricity Production, Ontario Power Generation

Dick Jessop is Director of Project Management, Electricity Production, for Ontario Power Generation. He is accountable for developing and providing project services to the Hydroelectric and Fossil businesses. Born in England, Dick emigrated to Canada in 1975. He joined Ontario Hydro in 1981 and has held various positions including Construction Superintendent, Senior Project Engineer, Manager of Fossil Services Division, and Manager of Fossil Business Programming and Development. He currently serves on the CII Implementation Strategy Committee and the Construction Project Improvement Conference Committee. Dick has a bachelor of science degree from the University of Manchester and an MBA from York University.

Taking Project Performance to the Next Level

At this 2000 CII Annual Conference, as at other CII Annual Conferences, the attendees have learned about the most recent research products and have heard results from several case studies from CII member organizations making effective use of the research results. The purpose of the presentation and this material is to inform the conference participants about the resources available for their use in selecting and implementing CII practices appropriate for their businesses and organizations.

The most comprehensive and yet the fundamental guide to the implementation process is found in the CII Implementation Model (see Figure 1). This process model, developed by the Implementation Strategy Committee (ISC), provides a guide to accomplish the important decisions, planning activities and the actions necessary to implement CII practices successfully.

The Implementation Model

One of the principal learnings of the ISC from its review of members' implementation efforts is: To achieve success in implementation of CII Best Practices it is vital that an emotional shift to a high level of commitment be demonstrated. This commitment to implementation is fundamentally different from member's contributions to CII research. Support of research basically requires the contribution of money by member organizations and support for the effort of individuals; the research is done collectively. Implementation, on the other hand, is accomplished independently by the member organizations. In addition to requiring people and funds, implementation of CII Practices requires real commitment or zeal for the process to be effective and for the intended results to be realized. The commitment must be strong and continuing, and is typically required from the Board of Advisor member and the business unit leaders in the member organizations.

With the information gained from the ISC study of member organizations' successes in implementation, a number of the successful techniques were fit together to form The CII Model for Implementation. This Model is shown in Figure 1 and is described in following sections. The ISC studies indicated that:

a. the high quality of CII products facilitates implementation,

b. that the more significant barriers to implementation are actually located within member organizations, and

c. that a number of "enablers" are available to overcome those barriers.

The Implementation Model is founded on three supporting elements or "foundations." These are:

a. CII products

b. CII support

c. Benefit/cost data related to the use of CII Best Practices.

Two of the foundations, CII Products and Benefit/Cost Data, are critical to the viability of the Model; both are necessary to support the Model. The third element of the foundation, CII Support, adds strength to the Model. This support can take a variety of forms, ranging from members agreeing to share their experiences and lessons learned in implementing CII Practices through Corporate Implementation Champions and Experienced Users to CII staff advice and assistance.

The foundations support the cornerstone of the Model, Corporate Commitment, which is fundamental to the success of implementation. Corporate Commitment can be demonstrated in a number of ways, but it must be real and must be continuing. The complete set of steps of the Model, in the sequence shown, produces the preferred version to support implementation of CII Best Practices. However, in certain circumstances the blocks of the Model, other than Corporate Commitment, can be arranged in differing sequences or may be modified.

The blocks of the CII Implementation Model are described in the sections below. Please refer to Figure 1 for the graphic display of The CII Implementation Model. In the context of this discussion, the terms “CII Best Practice,” “Best Practice,” and “CII Proposed Best Practice – Pending Validation” are essentially synonymous and are used to indicate a CII product that provides information on a recommended industry practice, developed through the CII research or implementation activities. These categories of CII knowledge are described in greater detail in the following section on the CII Knowledge Structure.

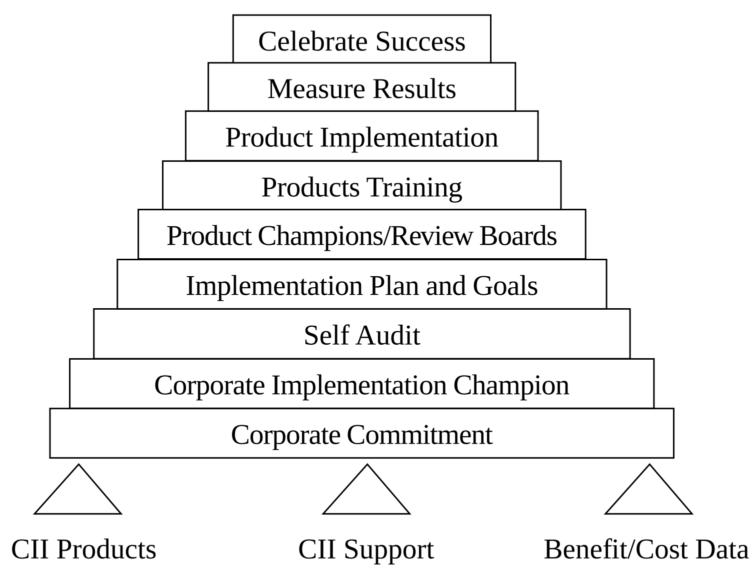


Figure 1. The CII Implementation Model

Corporate Commitment

The heart and soul of successful implementation is corporate commitment. Implementation of CII Best Practices requires that we change the way our organizations perform certain work processes, and we may have been doing it the old way for a long time. Wholehearted corporate commitment is essential to cause significant organizational change or for the work process change to occur.

How we achieve and display corporate commitment is unique to each of our organizations. While the methods to achieve and display corporate commitment may be different, the principles behind corporate commitment are similar across organizations. The greatest similarity is that corporate commitment must be sustained and must be genuine; the WALK must match the TALK. Another similarity is that the individuals in the organization responsible for the financial results must understand how successful implementation of CII Best Practices will improve the financial results.

Member organizations have successfully achieved and displayed corporate commitment in a variety of ways, including:

1. Publishing a statement/directive establishing the implementation of CII Products as one of the key objectives for the organization in the upcoming evaluation period. This statement/directive may include the types of CII products to be implemented, the desired implementation schedule, and the benefits that implementation is expected to provide.

2. Incorporating the implementation of CII Best Practices into the annual review process for senior management individuals and project managers. The senior managers are asked to identify how they keep abreast of CII Best Practices, how they share CII products with their employees, and how they measure the benefit of using CII Best Practices. The project managers may be asked to indicate the CII Best Practices implemented in their project and to provide periodic measures of the results attained.

3. Directing the incorporation of a specific CII Best Practices into the applicable processes or procedures of the organization.

Meaningful results from an organization’s involvement in CII depend largely on the internal implementation of CII Best Practices. All of the evaluations of implementation efforts have shown that the fundamental factor, the cornerstone, behind successful implementation of CII Best Practices is sustained and effective corporate commitment.

Implementation Champion (Corporate)

The Corporate Implementation Champion provides to the organization the corporate leadership and guidance for all CII implementation activities, and in particular provides the leadership and support to successfully implement selected CII Best Practices within the organization. The Corporate Implementation Champion must be a demonstrated leader and must have the personal attributes, the desire and the capacity to successfully accomplish the tasks shown below:

Leadership

- Establish and communicate company commitment to the implementation of CII Best Practices.
- Assess organization’ s current state and capacity for change.
- Establish a process for selecting CII Best practices for implementation.
- Establish a process for implementing CII Best Practices.
- Integrate selected CII Best Practices into organization work processes.
- Obtain and allocate resources: time, money, personnel to support the implementation efforts.
- Provide incentives for implementation.
- Promote/require the use of CII Best Practices within partner organizations.

Communication

- Communicate the benefits and value of CII Best Practices.
- Communicate expected behaviors relative to the use of CII Best Practices.
- Provide for training in CII Best Practices.
- Communicate successes achieved and opportunities for improvement.

Knowledge

- Have working knowledge of CII Best Practices.
- Experience in organization work processes.
- Raise the awareness of the organization to CII Best Practices.
- Provide for widespread availability of CII materials.
- Establish a mechanism for the review and distribution of new CII products.
- Provide opportunities for staff to participate in CII activities, teams, etc.

Measurement

- Measurement of the degree of implementation of CII Best Practices.
- Measure Project Performance attributed to CII recommendations.
- Measure and communicate the cost and benefits of implementation.

Self Audit

An early step in the Implementation of CII Best Practices is to conduct a self-assessment of the company's current level of CII knowledge and product implementation. The goals of the self-assessment should be to

a. understand on an objective basis the extent of implementation of the functional elements of the specific CII Best Practices being examined,

b. to assess the familiarity with the specific CII Best Practices and the perceived value of the CII products at the projects level.

Conducting such an assessment will also likely allow a company to gain an appreciation for any barriers which exist and that are preventing further implementation. CII's Implementation Resource 42-2, *Barriers to Implementation* was designed, in part, to serve as an internal assessment tool for companies seeking to determine the extent of implementation of CII Best Practices. Although the content of IR42-2 is currently being updated to reflect the CII Knowledge Structure, the Self-Assessment tool in Section 4 of IR42-2 is in the form of a survey/questionnaire covering 13 Key CII Concepts, these questions may be applied to the CII Best practices, with adjustments. The self-assessment tool is divided into three categories measuring the extent of:

a. Knowledge — the level of basic familiarity with the concepts and related publications.

b. Continuous Improvement Plan — the level of planning and documentation that provide evidence of the intent to implement the selected Best Practices.

c. Implementation Process — the extent that activities, procedures, and work processes incorporate the selected Best Practices.

The self-assessment tool is designed to produce a numerical implementation "score" which can then be compared against actual research data from 22 projects active during 1993 and 1994.

Other types of self-assessment techniques can also be used, including an assessment of an organization's work culture and readiness to accept new concepts and ideas; and the use of the CII Benchmarking Practice Use Questionnaires to provide an alternative measure of implementation. Implementing CII Best Practices often requires change within an organization and can be expected to trigger many of the same issues and concerns as do other types of organizational change. Understanding an organization's readiness and capacity for change therefore becomes an important aspect of the self-assessment process.

Implementation Plan and Goals

Implementation of selected CII Best Practices should be based on an implementation plan developed to accomplish specific program objectives or goals. The implementation plan need not be overly extensive, but should include a defined program scope, identify estimated resource needs, indicate timing, and specify expected benefits. With the goals in mind, the specific implementation plans and strategies become the road map and the means for achieving success. The goals provide the basis for measuring our progress along the way, and serve as the "vision" for what we want to achieve. Examples of specific plans might be:

- Establishment of a CII product review process.
- Establishment of CII Best Practices "owners" within the company.
- Setting up a CII Library or resource center within the company.
- Making CII products accessible over the company's network.
- Integration of CII Best Practices into the company's work processes and procedures.
- Development of measurement systems for utilization and results.
- Including CII usage of CII Best Practices in Individual's Measures of Performance.
- Building CII Best Practices utilization into partnership arrangements.

Product Champion and Product Review Board

As with other blocks of the Implementation Model, the functions the Product Review Board fulfills are roles that alternatively, the Product Champions may take. Selection of method for reviewing and selecting CII Best Practices for implementation will be highly dependent upon the culture within each organization. Member organizations have used various arrangements to perform the product review and product champion functions. Several examples are briefly discussed.

The Product Review Board is typically formed at an appropriate level within the organization to review all newly received CII products and to determine the applicability of the Best Practices to the organization. In one example, the Product Review Board reviews each CII Best Practice and provides specific recommendations on the usefulness of that Best Practice to the organization. The Board also indicates at which points in the work process the new information would be expected to be applicable. In another organization's example, a two-person team reviews each CII Best Practice to determine the applicability of the Best Practice to the organization's operations. That team also assigns indications of primary and/or secondary applicability for the Best Practice to specific phases of the internal project cycle. The following general steps are suggested:

1. Assign accountability

The first step in implementing a product review process is to assign accountability for carrying out the assessment of CII Best Practices. This responsibility can be the mandate of a single individual or of a team. The product review team will usually include cross-functional or cross-business unit managers. The team may also have other responsibilities in addition to product review; e.g., benchmarking, training, etc. The Product Champion may be assigned as each new Best Practice is received. Suggested duties for the Product Champion are shown below.

2. Determine fit of product with current processes

Before proceeding to implementation of a new product, there are a number of gates through which it must pass. The first gate is an assessment of whether the product will fit, improve or add something new to current processes for capital project development. If the current practice already incorporates much of a new product's ideas, the Product Review Board may suggest detailed review of the Best Practice to determine if any improvements noted in the CII recommendations should be incorporated in the existing process.

3. High level review by content expert

The product review team may not have the detailed expertise to assess the full usefulness of the Best Practice. A content expert within the organization should be asked for their review and opinion. This review could include some preliminary experimentation with the Best Practice.

4. Pilot trials

For Best Practices that show promise for process enhancement and are significant departures from normal practice within the company, a pilot trial is recommended. Responsibility for this trial could be assigned to a project manager. The project manager would be required to test the product on appropriate projects and to periodically report results of the test to the product champion/review board.

5. Recommendation for implementation

The final step is for the product champion/review board to make an implementation recommendation to the Corporate Implementation Champion. The recommendation would include steps for process documentation changes, training, communication and any specific hardware needs. Normal organizational change management processes should be used to the extent possible for the roll out.

The specific Product Champion is frequently assigned prior to or during this review process. The Product Champion is a respected leader within the organization who normally has functional responsibility in potential area of application for the Best Practice or product. The roles of the Product Champion include:

a. insuring that the selected Best Practice receives a full review for possible adaptation,

b. arranging and supervising pilot application studies for the product or Best Practice,

c. leading the analysis and decision process for Best Practice selection for full implementation, and

d. providing leadership and management for the full implementation of the selected Best Practice.

Product Training

Based on positive actions at each of the prior blocks of the Implementation Model, it is necessary to address how to provide the knowledge to all affected parties in order to be successful in the implementation of the selected Best Practice. There are a number of potential means to provide the requisite knowledge, and there are a number of resources to use. The magnitude of the change necessary to implement the Best Practice and the scope of the organizational impact of the change will suggest the nature of the educational program to support the implementation of the changed work process.

The educational programs to support change vary from the most simple of providing some reading material to the impacted employees, through attendance at scheduled training programs or CII Short Courses, to the development of a Project Management Academy, as two member companies have done. CII education material is developed in a manner to support self-study, internal presentation by member companies, presentation by training experts on a customized or regularly scheduled program. Information on the CII education material is available in the CII catalog or directly from the CII staff. A new CII education product category, the FasTrack Education Resources topics, has been developed to assist member organizations as well as the industry as a whole, by providing the basic elements of an education module in a “kit of parts” format. This will enable organizations with an internal training development capability to easily develop CII Best Practice-based education programs customized to their particular organization and work process. The FasTrack Education Resources are developed in parallel with the development of new education topics. To date, two FasTrack topics have been developed; Management of Environmental Remediation Projects and Pre-Project Planning. Additional FasTrack Education Resources will be made available in the near future.

Three universities provide instruction on selected CII Best Practices through the CII Continuing Education Short Courses. These are: Arizona State University, Clemson University, and The University of Texas at Austin. Information on the material presented in these courses and the schedule is available in the CII Web page and directly from the institutions concerned.

The newest means for distribution of CII education materials, the Technology Assisted Learning (TAL) system, will debut in late 2000. This system is intended to supplement, not to replace the current campus-based Continuing Education Short Courses. The TAL system will provide the learning contained in selected CII education modules through a two-tier system. Tier 1 involves the presentation of the fact-based elements of the CII education module through a computer interactive delivery to subscribers over the Internet on an anytime-anywhere basis, around the clock, around the world. Tier 2 consists of face-to-face workshops focused on the implementation of the CII Practice. Attendance in the Tier 2 workshop is predicated on successful completion of the Tier 1 course. Tier 2 Workshops may be presented at the locations of the current campus-based institutions or may be delivered in a customized format at the location selected by the client. As the Tier 1 portion will not require attendance at a training location, some of the net benefits include reduced time away from the job and the opportunity for more extensive awareness of the information through Tier 1 and 2 participation. Further, the Tier 2 portion will require less time than the Continuing Education format, thereby providing the full learning experience with reduced time away from the work. Additional details about the TAL system may be found in the portion of these “Proceedings” related to that topic.

Product Implementation

With successful completion of the actions covered by the supporting blocks in the Implementation Model, the actual implementation process will be clear and the potential for success will be enhanced. The organization should be made aware that implementation of the selected CII Best Practice is important to the corporate leadership, the employees should become knowledgeable of the potential benefits from implementation and they should have been trained on the use or application of the Best Practice. Through the development of the Implementation Plan and Goals, the possible barriers to implementation should be identified and the appropriate “enabler” actions to overcome those barriers should have been determined. The implementation process should be planned to provide the greatest set of benefits to the organization and the potential disruptions to operations should be minimized through planning, scheduling and training.

While the implementation may be on either a pilot, a decentralized or a centralized basis, the functional aspects of changing the work process requires that the steps contained in the Implementation Model be addressed and appropriate actions be taken to prepare for the successful change. In addition to providing the leadership necessary to prepare for the change, the leadership must also be careful to continue support for the changed process, especially at the time the change is made and during the period immediately following the implementation. Without the continued support of the organization's leaders, those who support the status quo will raise many of the barriers identified earlier in order to block the change. Without continued strong support from the organization's leadership, the new process can falter and the expected benefits will not be realized.

Measure Results

Learning organizations continuously monitor and improve their work processes. Measurement of results allows an organization to establish a baseline of performance and goals for continuous improvement. Results can be defined in terms of the utilization of certain concepts or practices, and the impact the utilization has on cost or schedule performance. A properly balanced measurement system should include both "use of" and "end results" measures. Some important questions to consider in designing measurement systems related to implementation include the following.

Are the proposed measures:

- The critical few for successful achievement of implementation goals?
- Able to be controlled by those being measured?
- Reasonably expected to result in the desired behavior?
- Expected to produce information of value greater than the cost to gather the data?
- Objective or subjective?
- Benchmarkable, internally and/or externally?
- Understood and accepted by key stakeholders?
- Able to be referenced to a "pre-implementation" baseline for measurement of changed performance?

Special care should be given to design a measurement system which is visible, understandable, and tracks continuous improvement.

Cost Benefit Data

The decision to implement any Best Practice is normally based on some comparative analysis of cost and benefits, with the benefits exceeding the costs by a reasonable margin. On occasion this information is displayed in a form of benefits to costs, with the greater positive number indicating the greater comparative benefit. Preliminary indication of the benefits from CII Best Practices is normally provided through the research process.

Since 1997 the CII Benchmarking and Metrics Committee's analysis of project-based information from more than 900 projects, representing an aggregate investment of $50 billion, have revealed the degree of practice use and the objective benefits associated with the use of selected CII Best Practices. These Benchmarking and Metrics Reports produce important data for decisions on implementation of CII Best Practices. Presently, the Benchmarking Reports provide use and benefits data on 8 Best Practices and the database is being expanded to provide coverage for all the CII Best Practices in the future.

CII Support

One of the elements of the foundation for The Implementation Model is CII Support. This support comes from a variety of resources. The goal of this support is to provide ready, qualified sources of experience and expertise on general CII implementation issues and specific CII Best Practices to assist member companies with their implementation efforts.

The primary sources of CII support consist of the support provided for the Corporate Implementation Champion and the Experienced User Program.

The Corporate Implementation Champions are supported through two annual Workshops conducted by the Implementation Strategy Committee. These Workshops provide considerable information on CII Best Practices, case studies on implementation, skill development for the Corporate Implementation Champions and networking opportunities with peer Implementation Champions. Additionally, a full-time Internet-based collaborative system is available for continual support of the Corporate Implementation Champion interaction. An experienced implementation consultant, supported by CII, facilitates this Internet interaction.

While the Corporate Implementation Champion's focus is necessarily organization-wide, and includes consideration of all the CII Best Practices, support on a practice-specific basis is available through the CII Experienced User program.

In the Experienced User Program, individual member organizations who believe they have been very successful with the implementation of a particular CII Practice may volunteer one or more of their knowledgeable employees to be identified to the membership as an "Experienced User." The Experienced Users are available, within the limitations their organization may establish, to assist other members in the implementation of the specific CII Practice. This assistance is available without charge and is provided on three optional levels:

Level I: The Experienced User communicates with those seeking information by any means possible.

Level II: The Experienced User invites the interested parties to visit the EU's offices to exchange information.

Level III: The Experienced User visits the location of the interested parties to exchange information.

The current list of CII Experienced Users is provided in the following section.

Additional sources of CII Support are the CII staff members, and the academic researcher(s) associated with the specific CII product of interest. The CII staff is focused in specific areas of CII operations and staff members are always available to counsel over the phone with member organizations. In addition, staff members are available for visits to a member company to provide advice, counsel and direction in relation to a specific CII product or program. The CII staff, based on availability, support short duration member visits of this type. Similar support may be available from the appropriate academic researcher(s) associated with the CII product of interest on a consultant basis.

All of these activities are to be directed toward helping the member organization implement a CII Best Practice more rapidly and efficiently.

CII Knowledge Structure

CII products resulting from the institute's research and implementation support activities have recently been arranged in the CII Knowledge Structure. This CII Knowledge Structure is based on 13 Knowledge Areas (listed below). Within the CII Knowledge Structure, the information is further divided into three major sub-divisions:

a. CII Best Practices

b. Proposed Best Practices – Pending Validation

c. Information Topics

Each of these categories is defined below.

CII Knowledge Areas

1. Front-End Planning
2. Design
3. Procurement
4. Construction
5. Startup and Operations
6. People
7. Organization
8. Project Processes
9. Project Controls
10. Contracts
11. Safety, Health and Environment
12. Information/Technology Systems
13. Globalization Issues

CII Best Practices

Presently there are 11 CII Best Practices.

Definition: A CII Best Practice is a process or method, that when executed effectively, leads to enhanced project performance.

Pre-Project Planning
Alignment
Constructability
Design Effectiveness
Materials Management
Team Building
Partnering
Quality Management
Change Management
Disputes Resolution
Zero Accidents Techniques

Proposed Best Practices – Pending Validation

Presently there are 12 Proposed Best Practices – Pending Validation.

Definition: A CII Proposed Best Practice – Pending Validation is a process or method that may become a CII Best Practice, but has not been sufficiently proven.

Early Estimating
Planning for Startup
Design for Maintainability
Employee Incentives
Management of Education and Training
Organizational Work Structure
Leader Selection
Implementation of Products
Lessons Learned
Managing Workers' Compensation
Environmental Remediation Management
Design for Safety

Information Topics

Presently there are 24 Information Topics.

Definition: Information Topics provide findings only, and do not provide processes or methods.

Piping Design
Design Standards
Cost Effective Engineering
Supplier Relationships
Competition
Attract and Maintain Skilled Workers
Craft Productivity
Multi-Skilling
Small Projects
Benchmarking and Metrics
Work Packaging
Cost & Schedule Control
Project Delivery Strategies
Contract Strategies
Use of Project Incentives
Risk Management
Automated Identification
Electronic Data Interchange (EDI)
Computer-Aided Design/Drafting
Fully Integrated and Automated Project Processes (FIAPP)
Wireless Technology
Automation and Robotics
International Standards
Global Construction Industry

Within each of the Best Practices and Proposed Best Practices topics, the information is further designated as Tools, Supporting Documents, and References. The Information Topics contain only Supporting Documents and References

The new CII products are reviewed annually for designation as Best Practices or Proposed Best Practices. The Proposed Best Practices topics are also evaluated annually for re-designation as Best Practices. We recommend that interested persons examine the most current listings in each category by opening the CII Web Site at *http://construction-institute.org* on the Internet and clicking on "Catalog," "Knowledge Structure," and then on their topics of interest. The column headings in the Knowledge Structure matrix indicate if the topic is a Best Practice, a Proposed Best Practice – Pending Validation or an Information Topic. The Knowledge Structure matrix on the CII Web site is linked to the electronic catalog. Clicking on any entry in the matrix will bring the associated CII product listing display to the screen.

The Knowledge Structure matrix can serve as a roadmap to assist you in selecting the CII practices and related products that will offer your organization the greatest benefit when implemented.

CII Experienced Users

The individuals listed below have offered to interact with CII members on implementing CII practices in the categories indicated:

Knowledge Area	Best Practices
1. Front-End Planning	*1.1 Pre-Project Planning; 1.2 Alignment*
	Derek Brown, Aramco Services Co. — 011-96635724382
	Rob Crosbie, Ontario Hydro — 416/592-6635
	Richard D'Ardenne, Phillips Petroleum — 949/263-8383
	Karl Fehrenkamp, S&B Engineers — 713/845-4864
	John Fish, Ford, Bacon & Davis — 225/297-3237
	Bob Germinder, Black & Veatch Pritchard — 913/458-6950
	Edd Gibson, The University of Texas — 512/471-4522
	Tom Gore, Graycor — 708/206-3633
	Dave Hile, Cherne Contracting Corp. — 952/944-4413
	Ronald Johnson, BE&K Construction Co. — 205/972-6682
	John Kopfer, S&B Engineers — 713/845-4077
	Chuck McFall, Tennessee Valley Authority — 423/751-6724
	Rob McNulty, DuPont Facility — 910/678-1286

Knowledge Area	Best Practices (continued)
1. Front-End Planning	*1.1 Pre-Project Planning; 1.2 Alignment*
	Rick Moore, Ford, Bacon and Davis — 713/845-4504
	Joe Narwich, Day & Zimmermann, Inc. — 215/299-5608
	Joe Nuccio, Day & Zimmermann Int'l — 302/453-3303
	Leopoldo Perez, Rohm and Haas Engr. — 215/785-7640
	Brett Phillips, S&B Engineers — 713/845-7807
	Paul Reinhard, DuPont Specialty — 302/992-4149
	Barry Schrock, DuPont — 512/776-6518
	John Springer, Kvaerner Process — 713/270-2800
	Chad Zollar, Champion International — 513/868-4624
	Proposed Best Practice
	1.3 Early Estimating
	New category — seeking nominations of Experienced Users

Knowledge Area	Best Practices
2. Design	*2.1 Constructability*
	Faisal Al-Turki, Aramco Services Co. — 011-9663862-5463
	Derek Brown, Aramco Services Co. — 011-96635724382
	Bob Buddingh, S&B Engineers — 713/845-4582
	Richard D'Ardenne, Phillips Petroleum — 949/263-8383
	Darrell Dickens, S&B Engineers — 713/845-7013
	Keith Fermanich, Cherne Contracting — 952/944-4417
	John Fish, Ford, Bacon & Davis — 225/297-3237
	Garry Hart, Black & Veatch Pritchard — 913/458-6250
	Andy Loftis, S&B Engineers — 713/845-7846
	Leopoldo Perez, Rohm and Haas Engr. — 215/785-7640
	Brett Phillips, S&B Engineers — 713/845-7807
	Chris Robinson, Ontario Power Generation — 519/431-1731
	Peter Smith, ABB Lummus — 409/963-0444
	John Spray, Day & Zimmermann Int'l — 864/241-2651
	Roman Szymberski, BE&K Constr. Co. — 312/795-6755

Knowledge Area	Best Practice
2. Design	*2.2 Design Effectiveness*
	Faisal Al-Turki, Aramco Services Co. — 011-9663862-5463
	Bo Bogaty, BE&K Engineering — 205/972-6202
	Matt Curtin, Rohm and Haas Engr. — 215/785-7206
	Stan Haber, Tennessee Valley Authority — 423/751-3838
	Dan Ioli, Day & Zimmermann Int'l — 215/299-8073
	Bill Johnston, Day & Zimmermann Int'l — 704/943-5205
	Steve Lorenz, DuPont Engineering — 302/774-2556
	Gerry Ohlhaver, Black & Veatch — 913/458-6488
	Charles Reid, S&B Engineers — 713/845-4543
	Paul Reinhard, DuPont Specialty — 302/992-4149
	Scott Swann, Rohm and Haas Co. — 281/228-8677

Knowledge Area	Best Practice
3. Procurement	*3.1 Materials Management*
	Bob Buddingh, S&B Engineers — 713/845-4582
	Charles Christy, S&B Engineers — 713/845-4286
	John Fish, Ford, Bacon & Davis — 225/297-3237
	Bob Germinder, Black & Veatch Pritchard — 913/458-6950
	Milt Gore, DuPont Engineering — 302/774-2556
	Dave Hile, Cherne Contracting Corp. — 952/944-4413
	Peter Manning, Ontario Hydro — 416/592-3430
	Dan Messer, BE&K, Inc. — 205/972-6568
	Joe Rossi, Day & Zimmermann Int'l — 215/299-8382
	Hiram Wilson, S&B Engineers — 713/845-5428
	Ron Zumwalt, S&B Engineers — 713/845-4200

Knowledge Area	Best Practice
4. Construction	See all other Best Practices and Proposed Best Practices.

Knowledge Area	Proposed Best Practices
5. Startup and Operation	*5.1 Planning for Startup*
	5.2 Design for Maintainability
	New categories — seeking nominations of Experienced Users

Knowledge Area	Proposed Best Practices
6. People	*6.1 Employee Incentives*
	6.2 Management of Education and Training
	New categories — seeking nominations of Experienced Users

Knowledge Area	Best Practices
7. Organization	*7.1 Team Building*
	Carolyn Dortch, S&B Engineers — 713/845-4180
	Avery Duncan, Day & Zimmermann Int'l — 804/327-1907
	Robert Heath, Rohm and Haas Company — 281/228-8244
	P. A. Hypes-Keogh, DuPont Engineering — 302/773-2891
	Gil Karlsson, Day & Zimmermann Int'l — 215/299-8341
	Tom Muchesko, Graycor, Inc. — 708/206-3638
	Ron Norris, DuPont Engineering — 302/774-1161
	John Raven, Rohm and Haas Engr. — 215/785-7253
	Charles Reid, S&B Engineers — 713/845-4543
	Jim Staudt, Rohm and Haas Co. — 215/785-7403
	Javid Talib, Black & Veatch — 913/458-6154
	7.2 Partnering
	Rich Akin, S&B Engineers — 713/845-4005
	Mark Blair, S&B Engineers — 713/845-4892
	Rick Braswell, BE&K Engineering — 334/304-3701
	Richard D'Ardenne, Phillips Petroleum — 949/263-8383
	Stretch Dunn, BE&K — 205/972-6659
	Rick Fultz, NPS Energy Services — 615/782-2967
	Dave Hile, Cherne Contracting Corp. — 952/944-4413

Knowledge Area	Best Practices
7. Organization	*7.2 Partnering (continued)*
	Bob Seay, Tennessee Valley Authority — 615/782-2913
	Janice Seward, S&B Engineers — 713/845-4546
	Randy Swartz, Day & Zimmermann Int'l — 704/943-5444
	Brad Teckenbrock, Graycor — 708/206-0500
	Bob Wasmund, DuPont Engineering — 302/773-1098

Knowledge Area	Proposed Best Practices
7. Organization	*7.3 Organizational Work Structure*
	7.4 Leader Selection
	New categories — seeking nominations of Experienced Users

Knowledge Area	Best Practices
8. Project Processes	*8.1 Quality Management*
	Richard D'Ardenne, Phillips Petroleum — 949/263-8383
	Mike Davis, Ontario Hydro — 416/592-7103
	Carolyn Dortch, S&B Engineers — 713/845-4180
	John Fish, Ford, Bacon & Davis — 225/297-3237
	Bill Hall, Day & Zimmermann Int'l — 704/943-5158
	Richard Haughee, S&B Engineers — 713/246-4983
	Dave Hile, Cherne Contracting Corp. — 952/944-4413
	Charles Reid, S&B Engineers — 713/845-4543
	Greg Rowell, DuPont Engineering — 302/695-0305
	Sue Steele, BE&K, Inc. — 205/972-6173
	8.2 Implementation of Products
	Rob Crosbie, Ontario Hydro — 416/592-6635
	John Cutts, BE&K Engineering — 205/972-6409
	Richard D'Ardenne, Phillips Petroleum — 949/263-8383
	John Fish, Ford, Bacon & Davis — 225/297-3237
	Bob Germinder, Black & Veatch Pritchard — 913/458-6950
	Mike Green, Phillips Petroleum — 806/275-2920

Knowledge Area	Best Practices
8. Project Processes	*8.2 Implementation of Products (continued)*
	Dave Hile, Cherne Contracting Corp. — 952/944-4413
	Dennis Martens, Black & Veatch 913/458-6066
	Brett Phillips, S&B Engineers — 713/845-7807
	Tim Rickards, Phillips Petroleum — 918/661-8303
	John Ward, Black & Veatch — 913/458-6840
	8.3 Lessons Learned
	New category — seeking nominations of Experienced Users

Knowledge Area	Best Practice
9. Project Controls	*9.1 Change Management*
	Allan Basso, Ford, Bacon & Davis — 225/297-3236
	Marvin Black, S&B Engineers — 713/845-4169
	Mark Blair, S&B Engineers — 713/845-4892
	Bob Buddingh, S&B Engineers — 713/845-4582
	Richard D'Ardenne, Phillips Petroleum — 949/263-8383
	Dick Del Bueno, BE&K Inc. — 205/972-6410
	Karl Fehrenkamp, S&B Engineers — 713/845-4864
	John Fish, Ford, Bacon & Davis — 225/297-3237
	Tom Gore, Graycor — 708/206-3633
	Dave Hile, Cherne Contracting Corp. — 952/944-4413
	John Kopfer, S&B Engineers — 713/845-4077
	Roger Leach, S&B Engineers — 713/246-6081
	Tricia Maxey, S&B Engineers — 713/845-7809
	Mark Mullen, Day & Zimmermann Int'l — 704/943-5262
	Brett Phillips, S&B Engineers — 713/845-7807
	Paul Reinhard, DuPont Specialty — 302/992-4149
	Paul Williams, Day & Zimmermann Int'l — 215/299-2328

Knowledge Area	Best Practice
10. Contracts	*10.1 Disputes Resolution*
	Joe Aitken, Ontario Hydro — 519/431-1703
	Nick Bouler, BE&K Construction Co. — 205/972-6602
	Pam McKinley, S&B Engineers — 713/845-4229
	Wayne Navarro, S&B Engineers — 713/845-4501
	Tom Stone, Cianbro Corporation — 207/487-3311
	Joe Ucciferro, Day & Zimmermann, Inc. — 215/299-8377

Knowledge Area	Proposed Best Practice
10. Contracts	*10.2 Managing Workers' Compensation*
	New category — seeking nominations of Experienced Users

Knowledge Area	Best Practice
11. Safety, Health, and Environment	*11.1 Zero Accidents Techniques*
	Rich Baldwin, BE&K, Inc. — 205/972-6649
	Joe Beam, Rohm and Haas Co. — 502/449-5522
	Alan Burton, Cianbro Corporation — 207/487-3311
	Richard D'Ardenne, Phillips Petroleum — 949/263-8383
	Mike Dittman, Champion International — 513/868-4384
	Keith Fermanich, Cherne Contracting — 952/944-4417
	Gaylon Fortune, Kvaerner Process — 918/476-5825
	Bennett Ghormley, S&B Engineers — 713/845-4373
	Garry Hart, Black & Veatch Pritchard — 913/458-6250
	Robert Heath, Rohm and Haas Company — 281/228-8244
	Bob Krzywicki, DuPont Engineering — 302/774-2486
	Chuck Leaberry, DuPont Engineering — 302/774-2493
	Jim Long, Dick Corporation — 412/384-1329
	Doug Mathews, Graycor — 708/206-0500
	Dave Paisley, Ontario Hydro — 519/431-1717
	Bruce Sellars, Day & Zimmermann — 864/241-2676
	Jim Staudt, Rohm and Haas Co. — 215/785-7403

Knowledge Area	**Proposed Best Practices**
11. Safety, Health, and Environment	*11.2 Environmental Remediation Management* Dwight Bedsole, DuPont Engineering — 302/792-1587 Edmond Laratta, Ontario Hydro — 416/592-7991 Richard Seay, BE&K, Inc. — 205/972-5102 *11.3 Design for Safety* New category — seeking nominations of Experienced Users

Knowledge Area	**Best Practices or Proposed Best Practices**
12. Information/ Technology Systems	None identified in this knowledge area.

Knowledge Area	**Best Practices or Proposed Best Practices**
13. Globalization	None identified in this knowledge area.

Suggested Sources of Information

1. CII Research Summary 42-1, *Barriers to Implementation of CII Concepts: An Overview*, August 1995. This document provides an executive summary of the findings and recommendations of the Barriers to Implementation Research Team.

2. CII Implementation Resource 42-2, *Guidelines for Implementation of CII Concepts—Best Practices for the Construction Industry*, August 1995. This documents provides the rationale and the tools that will enable the industry to improve their use of CII Best Practices.

3. CII Research Report 42-11, “Barriers to Implementation,” Gary R. Smith, The Pennsylvania State University, August 1995.

Taking Project Performance to the Next Level

Plenary Slides

Program Success Through Execution
Case Study: DuPont and JBEK

Learning Objectives

- "Stack the deck" for project success by focusing on leadership and teamwork.
- Gain consistent successful safety performance.
- Achieve better focus of business goals.
- Realize that teamwork improves performance.

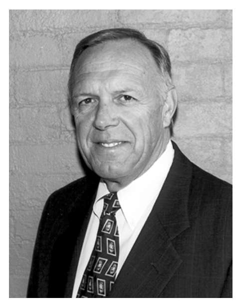
Abstract

This presentation will show how project performance improvements led to success by focusing on leadership and teamwork. Washington Works (a major DuPont site) moved from low levels of capital execution to successful completion of a major capital program that is concentrated in a congested area. The program's success spilled over to capital work on the site.

The details of the program's success will be provided utilizing actual results in safety, work force productivity, labor relations, state-of-the-art design tools, and deliverables/constructability planning using construction innovation, reduction of rework, comprehensive project controls integration, business results, and team relationships.

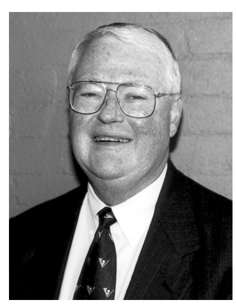
Plenary Session Presenters

Victor E. Kleinfelter – Director, Business Engineering, DuPont Fluoroproducts, DuPont



Vic Kleinfelter is Director, Business Engineering, for DuPont Fluoroproducts. He has been with the company since 1966 and has held a variety of engineering management positions, including assignments in Virginia, West Virginia, Indiana, Michigan, New Jersey, and Delaware. In 1993, he was named engineering manager of design and had responsibility for assuring that DuPont had the most competitive processes, systems, and resources to execute capital work. He has been in his present position for the past three and a half years, with responsibility for capital effectiveness and asset productivity. Vic is a civil engineering graduate of Ohio University.

John E. Rigby – Vice President, JBEK



John Rigby is Vice President of JBEK, a joint venture between BE&K and Kvaerner. He is responsible for serving the various DuPont businesses that have EPC, construction, and maintenance services. A native of Southern California, John began his career with the Los Angeles Department of Water & Power in the engineering and construction of power plants. He served in various executive and management capacities for contractors in both Florida and Texas before joining JBEK when it was formed in 1994. He is a civil engineering graduate of California State College-Long Beach and holds a master's degree in civil engineering from the University of Southern California.

Implementation Session Moderator

John E. Rigby, Vice President, EPC/Construction/Maintenance – JBEK

Implementation Session Participants

David Adams, Project Manager – Morrison Knudsen Corporation

J. Peter Ellefson, Regional Engineering Manager - Asia Pacific – DuPont Engineering

Victor E. Kleinfelter, Director, Business Engineering – DuPont Fluoroproducts, DuPont

Program Success Through Execution

Knowledgeable Points of Contact

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Program Success Through Execution

Plenary Slides

PIP — Working in Harmony to Change Industry

Process Industry Practices Initiative

Learning Objectives

- See how PIP Practices (currently totaling over 330) can improve project cost, schedule, and quality.
- Understand what is meant by “harmonization of standards for project implementation.”
- Use PIP Practices to reduce the cost of maintaining individual company standards.
- Learn how PIP Practices provide a baseline of quality to insure improved operational safety to the industry.

Abstract

Parallels will be drawn between the methodology of creation of the PIP Practices and the CII Best Practices as a comparison of techniques of research vs. harmonization. A PIP value proposition based on a cost study of an actual construction project will be discussed. Critical mass concepts and metrics will be introduced to demonstrate standards harmonization successes. A comparison of standards development and maintenance costs and timing for (a) typical member companies, (b) standards developing organizations, and (c) PIP practices will be shown. The harmonization process will be presented and examples given where it is now impacting a broader range of applicable organizations activities.

Plenary Session Presenter

Stephen C. Franke – Manager, Engineering Services Department, Engineering & Construction, Shell Chemical Company

Steve Franke is Manager, Engineering Services Department, Engineering & Construction, for the Shell Chemical Company. He also is Chairman of the Process Industry Practices (PIP) initiative, which is harmonizing industry standards for the process industry. He joined Shell in 1968 and has had extensive experience in technical and operations management roles at several Shell manufacturing locations. He has held a variety of positions, including roles in venture development, technical support management, project management, and startup management. He participated in the CII research on high performance project teams and has been involved with the PIP initiative since 1995. Steve holds a master’s degree in chemical engineering from Columbia University.

PIP — Working in Harmony to Change Industry

Summary

Many executives have been frustrated that their projects do not use common industry practices. In reality, common practices do not exist — and PIP is working to change this. The industry needs a common "sheet of music": project standards with harmonized technical details without differences that provide neither competitive advantage nor benefits to users. Eliminating needless variation will save the industry money, freeing resources to focus on opportunities that do provide competitive advantage to our companies and benefit to consumers.

Discussion

Most of the process industry companies in the U.S. are global companies competing on a worldwide basis. No U.S. or global set of voluntary, recommended practices exists for the detailed design, procurement, and construction of manufacturing facilities. Almost all the detailed design, procurement, and construction is done by contractor firms; few owner companies are doing their own production engineering and construction.

Similarly, no set of "industry standards" exists across the various technical disciplines. Various technical societies such as ISA, ASME, API, and ACI offer standards in specific areas. However, many required topics are not covered. Furthermore, because of the inherent "open" nature of these organizations, issuing a specific standard takes a considerable amount of time. For completion of project work, more specific and detailed specifications are required and these usually cite an array of industry standards as a design basis for the specification.

Most owner firms use company internal "standards" (practices/guides, etc.) that are provided to a contractor to "build a plant according to these." The result is that as the contractor's engineers move from one job to another, they must spend time learning a new set and often different sets of design practices. Likewise construction forces must learn a new set of installation practices, and procurement must be re-defined from job to job.

A preliminary comparison of the standards of several owner and contractor companies indicated that while the form of these standards was different, the substance was often essentially the same. It also appeared that most of the content of the various company standards was not considered proprietary. Each company seemed to have a portion of its standards, primarily process-specific for the owner companies and design-specific for the contractors, that it held confidential. The general commonality of substance and the small fraction held proprietary suggested the possibility for developing a common set of voluntary "industry practices."

The use of common practices enhances compliance with safety, health, and environmental objectives. A preliminary analysis also indicated capital savings of 2-5% of the total installed cost (TIC) of a plant. These projected savings include reduced engineering time, reduced field labor, and procurement savings. A recent PIP value proposition study based on an engineering style estimate for a project has indicated savings potential greater than 6% of TIC with the use of PIP's Recommended Practices.

Since its inception in 1993 PIP has grown to 33 member companies representing well over 50% of the U.S market share of process industry revenues. Using a harmonization process with many parallels to CII's research process, PIP has demonstrated its effectiveness. This streamlined short cycle process produces Practices to be used by qualified practitioners. Typical costs and elapsed time for creating its practices have been estimated to be well below those required by national standards development organizations.

A key principal of PIP is to support the development of voluntary recommended Practices based on a compilation and harmonization of member company existing internal standards. Recommended Practices based on new material are developed only where harmonization of existing material is not adequate and the need for the Practice is clearly demonstrated. Work that is being performed adequately by other organizations (e.g., ISA, API, ASME, ACI, etc.) is not duplicated. PIP seeks to work with and through those groups to identify and converge on a comprehensive set of industry practices.

PIP has been proactive and successful in its support of standards development organizations' programs. Collaborative and joint efforts have been completed and others are being established with API, ASME, and others. PIP has successfully petitioned the International Building Code to make its process industry-related standards on industrial equipment platforms more accepted internationally.

PIP member companies and subscribers enjoy the benefit of availability of all Practices electronically over the Internet. Hard copies of published Practices are available to non-members. Additional information is available from the PIP website at: *http://www.pip.org*.

Knowledgeable Point of Contact

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PIP — Working in Harmony to Change Industry

Plenary Slides

Breakthrough Strategy Today and Tomorrow

Breakthrough Strategy Committee — Implementation Session Only

Learning Objectives

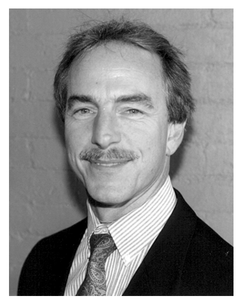
- See what breakthrough activities are currently under way.
- Learn about the breakthrough process for generating new topics.
- Find out how you can contribute to the process with your ideas.

Abstract

This session will focus on the process that developed the breakthrough program called FIATECH, Fully Integrated and Automated TECHnology. In addition to reviewing the breakthrough strategy methodology, the session will summarize the status of other potential breakthrough ideas that have been identified by the Breakthrough Strategy Committee. There will be time for a question and answer period and all participants will be encouraged to suggest new ideas that could be developed into the next CII sponsored initiative similar to FIATECH.

Plenary Session Presenter

C. Chatt Smith – Director of Project Definition, Stone & Webster Engineering Corporation



Chatt Smith is the Director of Project Definition for Stone & Webster Engineers & Constructors, Inc. in Houston, Texas. He is responsible for the development and implementation of the required tools, processes, and procedures to ensure best-in-class project planning/front end loading principles on all Stone & Webster projects worldwide. He has over 24 years of experience from both the owner and contractor perspectives in the petrochemical and engineering and construction industries. Chatt is a chemical engineering graduate of LSU.

Implementation Session Moderator

C. Chatt Smith, Director, Project Definition – Stone & Webster Engineering Corporation

Implementation Session Panelist

Daniel J. Maas, Chief Technical Officer – National Center for Manufacturing Sciences

Breakthrough Strategy Today and Tomorrow

Knowledgeable Points of Contact

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Houston, TX 77253
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Ned Givens
Associate Director
Construction Industry Insitute
3208 Red River Street, Suite 300
Austin, TX 78705-2697
P: (512) 232-3050   F: 512-499-8101
ngivens@mail.utexas.edu

Breakthrough Strategy Today and Tomorrow

Plenary Slides

Predicting the Impacts of Changes in the EPC Process

Impacts of Changes on the EPC Process Education Team — Implementation Session Only

Learning Objectives

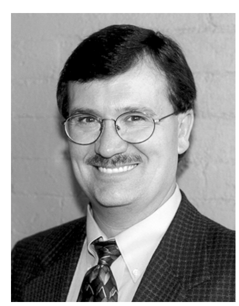
- Learn about the importance of work process modeling.
- Understand the significance of predicting and quantifying the cost and time impacts of work process modification(s).
- Realize the value of thinking in terms of improvement strategies, which may involve organizational, procedural, and technological drivers for change.
- Demonstrate how multiple work process improvement strategies can be compared and combined.
- Learn about the ABC-SIM simulation tool for predicting the cost and time impact of process change.

Abstract

CII Education Module 125-21 guides participants on the use of a CII-developed tool uniquely designed to measure the cost and schedule impacts of proposed changes to the EPC work process. Attendees will learn the importance of work process modeling and techniques to evaluate multiple improvement strategies and to determine their combined effect. Successful application of tools and techniques presented in this course will permit users to perform meaningful cost benefit analysis, enhance strategic planning initiatives, and improve efforts to identify and mitigate risk. ABC-SIM (Activity Based Costing Simulation) is a simulation tool that permits the user to predict and quantify the overall effect of various user-defined improvement strategies.

Implementation Session Moderator

Charles H. McFall, Jr. – Methods Manager, Fossil Power Group, Tennessee Valley Authority



Chuck McFall is the Methods Manager in the Fossil Power Group of TVA in Chattanooga, Tennessee. He has over 23 years of experience in the electrical utility business, 19 of those with TVA. He is responsible for the development, deployment, and improvement of processes and systems related to outages, work management, and performance initiatives. Chuck served as chair of the CII Determining the Impact of Process Change on the EPC Process Research Team and currently servesg as chair of the CII Education Team for the same subject. He also is a member of the CII Product Review Board. Chuck holds bachelor's and master's degrees from Tusculum College and a doctorate from Columbia Southern University.

Implementation Session Panelists

W. Edward Back, Assistant Professor – Clemson University

Stanley M. Haber, Project Engineer – Fossil Engineering, Tennessee Valley Authority

Donald A. Maxwell, Professor – Department of Civil Engineering, Texas A&M University

Douglas L. Saxon, Electrical Engineer, U.S. Army Engineering District, Savannah

Predicting the Impacts of Changes in the EPC Process

Introduction of CII Education Module 125-21

This new education module guides participants on the use of a CII developed tool uniquely designed to measure the cost and schedule impacts of proposed changes to the EPC work process. Attendees will learn the importance of work process modeling and techniques to evaluate multiple improvement strategies and to determine their combined effect. Successful application of tools and techniques presented in this course will permit users to perform meaningful cost benefit analysis, enhance strategic planning initiatives, and improve efforts to identify and mitigate risk. ABC-SIM (Activity Based Costing Simulation) is a simulation tool that permits the user to predict, and quantify; the overall effect of various user defined strategies. The course objectives are to:

- Learn about the importance of work process modeling.
- Understand the significance of predicting, and quantifying, the cost and time impacts of work process modification(s).
- Realize the value of thinking in terms of improvement strategies which may involve organizational, procedural, and technological drivers for change.
- Demonstrate how multiple work process improvement strategies can be compared and combined.
- Learn about the ABC-SIM simulation tool for predicting the cost and time impact of process change.

Activity Based Costing

Many industry practitioners have advocated activity based costing (ABC) as a method of improving cost management of a complex work process. Activity based costing determines the cost for any given process by examining the individual activities or tasks that comprise the process, and then assigning a cost to each. This technique provides very insightful information to an organization regarding the actual costs incurred to perform a work process. The underlying philosophy of ABC is that certain activities are carried out in the “manufacture” of products. These activities consume a firm’s resources, thereby creating costs. By determining the amount of resources (and the resulting cost) consumed by an activity, and the amount of an activity consumed in manufacturing a product, it is possible to directly trace manufacturing costs to products.

Although one may certainly argue that the engineering and construction industry is not a manufacturing process by the classic definition, it is still undeniably true that both designers and constructors alike manufacture products, whether the products are physical components of a structure, or a paper product such as a corporate purchase order. The processes used to manufacture construction related business products such as engineering design documents, requisitions, requests for quotation, purchase orders, receiving reports, and invoices are essentially an interrelated network of discrete activities performed by various participants, both internal and external to a company. Understanding the activities necessary to generate such documents or business transactions, and accounting for the resources they individually consume, is prerequisite for effective cost management.

ABC systems focus on activities and the associated cost of those activities, rather than on the final accumulated cost of end products. ABC systems act as a data provider regarding the operation of a process. Such systems also inform management of the rate that individual activities are consuming corporate resources. With such information, companies can better manage process change and develop strategic plans for work process improvement and corporate reengineering. Companies utilizing ABC systems can, therefore, be creative and proactive, rather than reactive, in their effort to reduce costs associated with any given project-essential process.

Monte Carlo Simulation of Process Models

Monte Carlo simulation is an excellent tool for applying activity based costing techniques. For process analysis, it is desirable to compare process cost to process schedule and then determine the level of impact that certain proposed process changes have on these baseline performance measures. However, when activity durations are known to be probabilistic and the process itself is known to be highly variable, having certain activities that are known to occur only occasionally, the ability to generate time vs. cost process data becomes burdensome and often infeasible. Discrete event, or activity based simulation, as an analytical tool, provides a vehicle to overcome the analytical difficulties in complex process structures.

If a given process under investigation is comprised of activities with non-variable durations, and if the process itself has no activities occurring simultaneously with another, and each and every activity always executes each time the process is conducted, then the process schedule could be calculated by simply summing all activity times. Similarly, the process cost could be derived by simply multiplying each activity time by the cost to perform that activity. This is clearly not realistic. In the real world of project delivery, engineering, construction, and administrative processes are far more complex, having simultaneous occurrences of activities. The cycle time, or process schedule, is actually the total time that has “elapsed” in performing the process. The process costs, however, are predicated, not on the cycle time, but on the time required by each activity to complete its individual task. As the activity durations, or execution times, become stochastic ranges, they must be described as probability distributions. The activity cost, as a function of activity time is, therefore, variable as well. As the process model becomes variable, with different paths for process execution, the ability to determine accurate process cost and schedules approaches analytical impossibility without employing Monte Carlo simulation.

Adding to the complexity of the analysis is the reality that costs within a process may not always be a function of time. Some activities may in fact consume resources, however, the resource requirement is not time dependent, but rather time independent, and can best be represented by a constant, rather than a time dependent variable. Similarly, some activities consume time without also consuming resources (costs). These may be represented in several ways in a process model and include: 1) activities that serve to delay other activities, and 2) queues that prevent activities from executing until certain prerequisite conditions are satisfied. Yet another level of complexity is introduced when rework loops are incorporated into process models. This means that some percentage of the time, as determined by the modeler, certain activities must be repeated or reworked. Often when modeling a rework situation, new activities are introduced that would otherwise not execute such as “demolition of existing work” or correction of flawed contract documents. Durations and associated assigned costs for rework activities, often exceed the original activity parameters and, thus, are required to be carefully modeled as separate “branches” in the process. In addition to rework conditions, other situations may occur only occasionally in a given process. These occasional occurrences further add to the variability and complexity of process models.

Monte Carlo simulation, by making numerous individual passes through the prescribed process network, can generate output distributions that enable quantitative analysis with respect to process time and cost. In doing so, simulation can help management understand the complex relationship between time and cost for a given strategic process. The distribution for time and cost for a process that is highly variable will obviously be different. However, armed with this quantitative date, management can make strategic, activity level improvements to a process and be predictive about the impacts to process cost and schedule, thus enabling them to meet or exceed corporate objectives.

EPC Activities and Activity Logic

Process models at two different levels of detail were developed for the Construction Industry Institute. First was the EPC macro model with descriptions at the activity level. At the macro level, the process is described generically from pre-project planning through startup. The second level of detail is the micro level, with process units described at the task level. Micro models were developed to “drill down” (or decompose) selected activities from the macro model. At this level, the process is described from activity start to activity completion.

Although there may be differences in project execution based on specific facility type or location, a distinct differentiation was not made for the purposes of this research. Likewise, companies executing similar projects may perform the process with some variation due to the uniqueness of their management approach or specific project requirements. The models developed by this research are not intended to be company, project, location, or situation dependent. The EPC macro model has been developed as a generic model, intended for wide industry use without limitation to project specifics. Individual companies wishing to use the EPC macro model may easily modify it to more accurately represent the unique characteristics of their own project processes.

The EPC Macro Model consists of two elements, an activity list and a graphical logic diagram. While the activity list is simply a listing of activities commonly executed in an EPC project, the logic diagram identifies the relationships between these activities. The logic diagram is a schematic representation of a typical project process sequenced from start to finish. The EPC Macro Model serves as a baseline condition, against which impacts resulting from process changes are compared and measured.

The activity list describes activities encountered in a typical EPC project execution approach. There is no relationship shown between the activities in the list since it is not intended to be indicative of process flow. The list is a consolidation of ideas, comments, and suggestions from practitioners representing more than 40 U.S. companies. One owner company's outline for project execution was used as a starting point for the activity list development. This was used to solicit comment and critique from the other participants in the process. Once the preliminary list was developed, it was circulated broadly to obtain additional reviews by other companies and individual practitioners. Multiple industries were represented in this process including owner and contractor companies from the petro-chemical, power generation, and pulp and paper sectors.

Since the input was obtained from experienced personnel of both contractor and owner companies, representing a wide range of facility types, the activity list is not expected to summarize any one company's process explicitly, nor be inclusive of all possible activities for every unique EPC project undertaken. Rather, the activity list includes only those activities most commonly executed by a significant portion of the industry to complete a conventional project. It was necessary to develop a list at a level of detail that allowed for the later development of the interrelationship between activities while still maintaining a generic industry model. The activity list contains three levels of detail as follows:

Level one consists of the five primary phases of project execution in an EPC process:

- Pre-Project Planning
- Design
- Materials Management
- Construction
- Startup

Level two of the activity list defines broad subdivisions or categories of the work performed in each of the five primary phases. For example, when performing pre-project planning, the following level two activities would be common in an EPC process:

- Development of a detailed business plan
- Development of a product technical plan
- Facility scope planning
- Development of a project execution plan
- Definition of the project's contract strategy

Level three is a further refinement of the hierarchical activity listing and defines specific project activities which commonly occur in an EPC project execution strategy. There are 164 level three activities summarized in this research.

The EPC Logic Diagram consists of all level three activities linked together in a precedence relationship. All 164 activities were incorporated along with 16 key process milestones. The EPC Logic Diagram represents the process, or flow, in which activities may typically be executed in an EPC project. Similar to the activity list, the logic diagram represents the consensus view of the numerous contracting companies who participated in the model's development. This process logic may easily be modified by the user to reflect a specific project or management approach. While it is beyond the scope of this paper, principally due to size and complexity, to present the actual EPC logic diagram developed in the research, the reader is referred to publications available from Construction Industry Institute: CII RS125-1 and CII IR125-2.

Time and Cost Estimations

Actual time and activity cost data, from approximately 20 large industrial construction projects, were collected for each level three activity in the EPC logic diagram. To account for the variation in time and cost associated with the variety of facility types and locations included in the data collection at the "macro level," the data is represented as a low, most likely, and high value (a triangular probability distribution). Least squares minimization was applied to the original data sets to develop the probability distributions.

Each one of the values in the triangular distribution is expressed as a percentage. The percentage should be thought of as the contribution of each activity toward the total project cost or total project time requirements. The EPC logic diagram, with time and cost values associated with each of the 164 activities, represents the baseline condition against which future (proposed) process improvements can be compared.

Simulation Tool

Activity Based Costing – Simulation (ABC-SIM) is a Monte-Carlo software package specifically developed to enable process analysis research. To use ABC-SIM, the EPC process is modeled as a node and link network. The nodes represent the required activities and process resources while the links provide the control mechanism to ensure that the prescribed precedence logic is maintained during simulation. ABC-SIM network logic is similar to the “activity on node” or precedence networks commonly used in schedule planning (CPM or PERT) or cyclical process analysis (e.g., CYCLONE Simulation).

The ABC-SIM tool is designed to provide a means of evaluating the time and cost impacts to highly variable processes such as the EPC process modeled in this research. The simulation process yields output measures for the:

- total activity time required to execute all activities defined in the process,
- total activity cost required to execute all activities defined in the process, and
- total elapsed time (calendar time) required to fully execute the process with the defined precedence logic.

By quantifying the degree of change in each of these three performance measures, as proposed process improvements are modeled and experimentally applied, it is possible to predict the resulting impact to project schedule and cost. Although the predicted outcomes will not precisely reflect the real world, they provide strong indications of potential project impacts. “Before” and “after” process conditions can be modeled, simulated, and then analyzed to determine the time and cost impacts of proposed process changes required to fulfill corporate strategic initiatives.

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Kennedy Space Center Florida — Constructing A Future

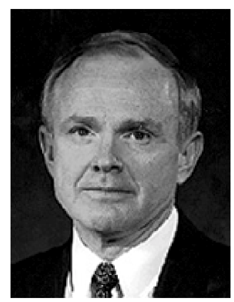
Banquet Speech: Roy Bridges, Jr.

Abstract

The National Aeronautics and Space Administration (NASA) is an expansive federal agency that includes Kennedy Space Center as one of 10 centers nationwide. Kennedy Space Center in Florida is attempting to construct a brilliant future for all of us on planet Earth. Guided by a strong Strategic Plan, Kennedy Space Center is leading the way toward space exploration and making the necessary advancements required for an exciting future.

The Kennedy Space Center is a multifaceted area that depends heavily on the construction industry. The unique construction at the center helps facilitate the implementation of our mission objectives. In addition, construction is important to NASA's International Space Station (ISS) objectives. The assembly sequence for the ISS is one of the most complex construction endeavors ever attempted. Many construction concerns are exacerbated when attempting a project that is 200 miles above the earth. Being able to unlock the secrets of space is a vital key to our future survival, and the construction industry is vital as a means to this end.

Keynote Speaker



Mr. Bridges became the Director of the John F. Kennedy Space Center in 1997. He is responsible for managing all NASA facilities and activities at the Kennedy Space Center related to processing and launch of the Space Shuttle, integration of NASA payloads, and final development and preparations of International Space Station elements to be flown aboard the Space Shuttle. He manages a team of 1,650 NASA civil service employees and 9,000 contractor employees.

Mr. Bridges is a retired U.S. Air Force Major General who held many key space-related roles during his career. After completing pilot training, he was assigned to a tactical fighter wing and flew 226 combat missions in Vietnam. He later served as a T-37 instructor pilot, test pilot, and Headquarters Air Force staff officer. He went to work for the Deputy Chief of Staff for Research and Development at Headquarters USAF in Washington, D.C., as a special assistant to the Deputy Chief of Staff for Research and Development. Prior to his last USAF assignment at Wright-Patterson Air Force Base, he was the Commander, Air Force Flight Test Center at Edwards Air Force Base in California. He also was Commander of the Eastern Space and Missile Center at Patrick Air Force Base in Florida.

Mr. Bridges was selected as an astronaut candidate by NASA in 1980, and piloted the Space Shuttle Challenger on STS-51F, and the Spacelab 2 mission, completing 126 orbits. The Spacelab 2 mission, the first to operate the Spacelab Instrument Pointing System (IPS), carried 13 major experiments. With the completion of this flight, he has logged 188 hours in space and more than 4,460 flying hours. Following his astronaut duty, he commanded a flight test wing, a space launch center, and the Air Force Flight Test Center.

Education:

Distinguished Graduate, bachelor of engineering science degree, U.S. Air Force Academy, Colorado Springs, Colorado, 1965.

Master of science degree in astronautics, Purdue University, Indiana, 1966.

USAF Test Pilot School, Edwards Air Force Base, California, 1971.

Distinguished Graduate, Air Command and Staff College, Maxwell Air Force Base, Alabama, 1976.

University of New Hampshire Executive Development Management Program, Durham, 1988.

Special Honors:

3 Air Force Distinguished Flying Crosses

15 Air Medals

Air Force Commendation Medal

Air Force Meritorious Service Medal

Air Force Systems Command Certificate of Merit

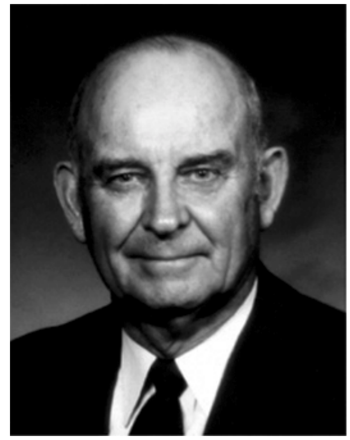
Distinguished Graduate of USAF Pilot Training

Top Graduate of the USAF Test Pilot School

Distinguished Graduate of the Air Command and Staff College

Recipient of NASA Certificate of Commendation

Carroll H. Dunn Award of Excellence



The Carroll H. Dunn Award of Excellence is CII's highest recognition. It was established in 1985 as a tribute to the original recipient, Lt. Gen. Carroll H. Dunn (U.S. Army, Retired).

Gen. Dunn led the Construction Industry Cost Effectiveness (CICE) Project, a study of the industry by The Business Roundtable. CII was established in response to a CICE recommendation that the industry needed a national research organization. Gen. Dunn had successful careers in the military and in the public and private sectors of the engineering and construction industry. He is retired and lives in Fort Belvoir, North Carolina.

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, who is selected by the Executive Committee of the Board of Advisors, is apparent.

Criteria for Selection

- 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.

Previous Recipients

Carroll H. Dunn (1985)
Charles D. Brown (1986)
Ted C. Kennedy (1988)
Robert H. Miller (1989)
Louis Garbrecht, Jr. (1990)
Clarkson H. Oglesby (1991)
James M. Braus (1992)
Gary D. Jones (1993)
Jack E. Turner (1994)
Daniel J. Bennett (1995)
John W. Morris (1996)
Richard L. Tucker (1997)
Edward W. Merrow (1998)

Dunn Award Recipient
Donald J. Gunther

Donald J. Gunther is the fourteenth recipient of the Carroll H. Dunn Award of Excellence. He exceeds all criteria for the award and his acknowledged leadership adds distinction to CII's highest recognition.

Don Gunther was born in New York City in 1938. He graduated with a degree in civil engineering from the University of Missouri at Rolla. He immediately joined the U.S Army and served in the Corps of Engineers, where he achieved the rank of Second Lieutenant with the Construction Engineering Battalion.

Mr. Gunther's extraordinary 37-year career with Bechtel began in 1961, when he joined the company as a field engineer. He served with great distinction in a wide variety of field engineering, supervision, and project management assignments, and then continued on at the executive leadership level. He personally helped build many of Bechtel's biggest signature projects, established some of its most important customer relationships, and was a driving force behind the company becoming the number one engineering and construction contractor in two hemispheres. Most importantly, Mr. Gunther's personal example of dedication and team-based, results-oriented leadership will be a permanent role model for Bechtel leaders.

In 1973, he became manager of the construction department staff. Between 1975 and 1978, he was involved in a large $2 billion Syncrude project in Alberta, Canada, where he made his mark as an extraordinarily energetic project manager who was personally knowledgeable about practically every nut and bolt on the project.

In 1980, he was appointed manager of the Houston office and elected a senior vice president. He returned to the West Coast two years later, and in 1985 became director, vice president, and general manager of the San Francisco division. In 1989, Mr. Gunther became president of Bechtel, Inc. During this period, Mr. Gunther led these businesses during some tough times and pioneered quality management in the industry and in Bechtel.

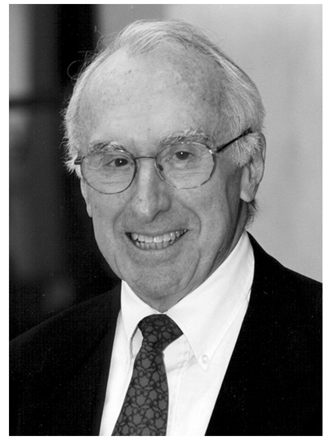
In 1992, he piloted the concept of a "region" in Bechtel, and his vision led to the company restructuring its global organization into regions, regional industry units, global industry units, and functions. Mr. Gunther returned to Houston in 1996 and led the North America and Bechtel Systems & Infrastructure organizations. He was elected vice chairman in 1997, an office in which he served with great distinction before retiring in July 1998.

Mr. Gunther recognized and identified with the team building efforts of CII. He is a former member of the CII Executive Committee and chaired the 1990 CII Annual Conference. He and his wife, Mosey, live in Naples, Florida. Their four children are all grown.

(Mr. Gunther was unable to accept the Dunn Award personally in 1999, and CII is grateful for his decision to attend the 2000 Annual Conference and to receive the award belatedly.)

Dunn Award Recipient

Arthur J. Fox, Jr.



Arthur J. Fox, Jr., is the fifteenth recipient of the Carroll H. Dunn Award of Excellence. He exceeds all criteria for the award and his wide-ranging perspective of the industry adds stature to CII's highest recognition.

Art Fox was born in Brooklyn, New York, in 1923. He received his BS in Civil Engineering from Manhattan College in 1947. He was awarded an Honorary Doctorate from his alma mater in 1982.

Mr. Fox began his engineering career as a rodman in the Columbia County (NY) Highway Department in 1941, and later worked as a draftsman for a private engineering firm in New York. During World War II, he served in the U.S. Army infantry as a construction foreman in the European theatre and was awarded the Bronze Star.

In 1948, he joined *Engineering News-Record* magazine as an assistant editor. He rose through the ranks to become *ENR*'s managing editor in 1960. In 1964, he was appointed Editor of the magazine. During his 24 years as Editor, he helped to establish *ENR* as the primary periodical publication of the industry. He launched *ENR*'s "Man of the Year" award and associated dinner, which is now an annual award in its thirty-fifth year. In 1987, he founded *ENR*'s Construction Industry Presidents Forum, which has now evolved to the Construction Industry Round Table, an association of 100 CEOs of the leading engineering and construction firms. While with *ENR*, he traveled around the world to report on construction news. In 1988, and after 40 years with the magazine, he retired as Editor Emeritus.

Mr. Fox has received numerous awards. The Beavers awarded him its Golden Beaver Service Award in 1988. He also is a member of the Moles. He is a past president of the American Society of Civil Engineers. He has been recognized by the American Consulting Engineers Council and the National Utility Contractors of America, among others.

Long a proponent of unity-building organizations within the industry, Mr. Fox was among the founders of the National Construction Industry Council and the American Association of Engineering Societies. He also has a keen interest in construction education and research, and was the keynote speaker at the Construction Industry Institute Annual Conference in 1988.

According to an industry representative, "Art has long been deserving of recognition from the heavy construction industry for his expert and incisive coverage of major construction projects and activities throughout the world. His magazine's in-depth reporting on all matters of concern to contractors, architects, and engineers should be 'must' reading for college students planning to enter the construction profession."

Mr. Fox is an honorary member of the American Institute of Architects, a Fellow in the ASCE, and a past trustee of the American Academy of Environmental Engineers. He has a son and daughter who are successful in their own careers. Widowed in 1991 after 45 years of marriage, he remarried in 1993 and currently resides in Potomac, Maryland.

Outstanding CII Researcher for 2000

Dr. Jeffrey S. Russell

Dr. Jeffrey S. Russell has been selected to receive the CII Outstanding Researcher Award for 2000. Dr. Russell is a professor at the University of Wisconsin-Madison and serves as chair of the UW-Madison Construction Engineering and Management Program.

Dr. Russell's research interests include developing decision-support tools for the managerial aspects of construction, particularly constructor prequalification, surety bonds for construction contracts, constructor failure, constructability, and construction automation and robotics. He has taught such topics as surety contract bonding, construction project management, constructability analysis, construction equipment and heavy construction methods, and construction automation.

Dr. Russell has been involved with the CII research program for the past 10 years, and has served on three CII research teams: Constructability Implementation, Predictive Tools, and Design for Maintainability. He is currently working on the CII Education Module for Designing for Maintainability. He is a recipient of four national American Society of Civil Engineers (ASCE) awards: the Collingwood Prize, the Edmund Friedman Young Engineer Award, the Walter L. Huber Civil Engineering Research Prize, and the Thomas Fitch Roland Prize. He has co-authored numerous articles for ASCE journals and currently serves as the editor-in-chief for the society's *Journal of Management in Engineering*. He is the author of two books for ASCE Press: *Surety Bonds for Construction Contracts* and *Constructor Prequalification: Choosing the Best Constructor and Avoiding Constructor Failure*.

Dr. Russell received his bachelor's degree from the University of Cincinnati and master's and doctoral degrees from Purdue University. He served as general chair for the 1997 ASCE Construction Congress held in Minneapolis, Minnesota.

Award Criteria

- The research significantly contributed to the improvement of the construction industry.
- The research is completed and products delivered.
- The researcher's excellence is recognized by his or her CII team members, the staff, and the membership.
- The researcher's report to CII is innovative, well written, and timely.

Individuals may be nominated for any of the awards by any of the following:

- An individual member from a CII research or project team, submitted through the team chair or project manager.
- A member of the CII Research Committee.

- A member of the CII Academic Council.
- Any CII member company's Board of Advisors Member or Alternate.

Previous Recipients of the Outstanding CII Researcher of the Year Award

1995 – Dr. Mike Vorster, Virginia Polytechnic University

1996 – Dr. Edd Gibson, The University of Texas at Austin

1997 – Dr. Stu Anderson, Texas A&M University

1998 – Dr. Gary Oberlender, Oklahoma State University

1999 – Dr. Ed Back, Texas A&M University

Outstanding CII Researcher Award Panel of Judges

Paul Campbell	Senior Vice President, Administration and Technology, M. A. Mortenson; Chair, CII Research Committee
Emerson Johns	Global Financial Manager, DuPont; Co-Chair, CII Research Committee
Gary Oberlender	Professor, University of Oklahoma; member, CII Academic Council
Reg Gagliardo	Burns and Roe Enterprises, Inc.; member, CII Academic Council
Les Prudhomme	Associate Director for Research, Construction Industry Institute

Outstanding CESC Instructor for 2000

Gary L. Aller

Gary L. Aller has been selected to receive the CII Outstanding Instructor Award for 2000. Mr. Aller is Director of the Alliance for Construction Excellence (ACE) at Arizona State University.

For the past eight years, Mr. Aller has been associated with ACE. His current responsibilities as Director cover all business operations of the organization. ACE is an outreach-inreach organization of Arizona State University for the construction industry. One particularly successful program at ACE is its serving as an educational hub for the Construction Industry Institute.

Mr. Aller's accomplishments as an instructor for the CII Continuing Education Short Course (CESC) program have been outstanding. He has consistently received high ratings for his presentations on numerous CII educational topics including development and alignment of project objectives, pre-project planning, zero accidents, scope definition and control, and design effectiveness. The high ratings reflect his ability to incorporate his insights from 29 years in the industry into his teaching. His style has been described as both a facilitator and a coach to the hundreds of CESC students who have completed his courses. Along with serving as a CESC instructor, he has served on the CII Education Material Development Board since 1996. He has contributed to the writing and completion of six CII Education Modules.

Mr. Aller's background includes responsibilities as project manager and other senior management positions with Bechtel, Ebasco, and J. B. Rogers Mechanical Contractors. He holds bachelor's and MBA degrees from National University, San Diego, California.

Award Criteria

- The individual is an effective instructor whose contributions, talent, and efforts have been recognized by the participants in the CESC courses. This includes the ability to present the information in interesting and innovative ways.
- Individuals receiving the award shall have earned it for contributions to CESC modules on two or more occasions.
- The individual has not previously received this award.

Previous Recipients of the Outstanding CESC Instructor Award

1995 – Dr. Jorge Vanegas, Georgia Tech

1996 – Mr. Stan Nethery, Dow Chemical

1997 – Dr. Steve Sanders, Clemson University

1998 – Dr. Edd Gibson, The University of Texas at Austin

1999 – Mr. Don Shaw, Ontario Hydro

Outstanding CESC Instructor Award Panel of Judges

Carol Arnold	Functional Excellence Leader, DuPont Engineering; Co-Chair, CII Education Committee
William Badger	Director, Del E. Webb School of Construction, Arizona State University; member, CII Education Committee and CII Academic Council
Frank Eskridge	Director, Construction Industry Cooperative Alliance, Clemson University; member, CII Education Deployment Board
Chris Hyvonen	Senior Vice President, Kiewit Industrial Co.; Co-Chair, CII Education Committee
Peter Miller	Senior Vice President, Kiewit Co.; member, CII Academic Council
Jesse Pfeiffer	Program Director, Construction Industry Programs, Center for Lifelong Engineering Education, The University of Texas at Austin; member, CII Education Material Development Board
Robert Ryan	Associate Director for Education and Implementation, Construction Industry Institute

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