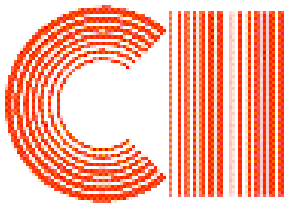
Summaries of ECI Value Enhancement Practices

March 1999

European Construction Institute



CONSTRUCTION INDUSTRY INSTITUTE

ECI Benchmarking Steering Committee

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March 1999

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Benchmarking Steering Committee

Summaries of Value Enhancement Practices

Preface

Measurement is the precursor to enhancement. Thus, an important aspect of the work of both the ECI and its American counterpart, the Construction Industry Institute (CII), is the benchmarking of the effect on project performance of a number of Value Enhancing Practices (VEPs). These VEPs relate to the following elements of project execution

- Team Building
- Strategic Alliances
- Pre-Project Planning
- Design / Information Technology
- Constructability
- Project Change Management
- Safety

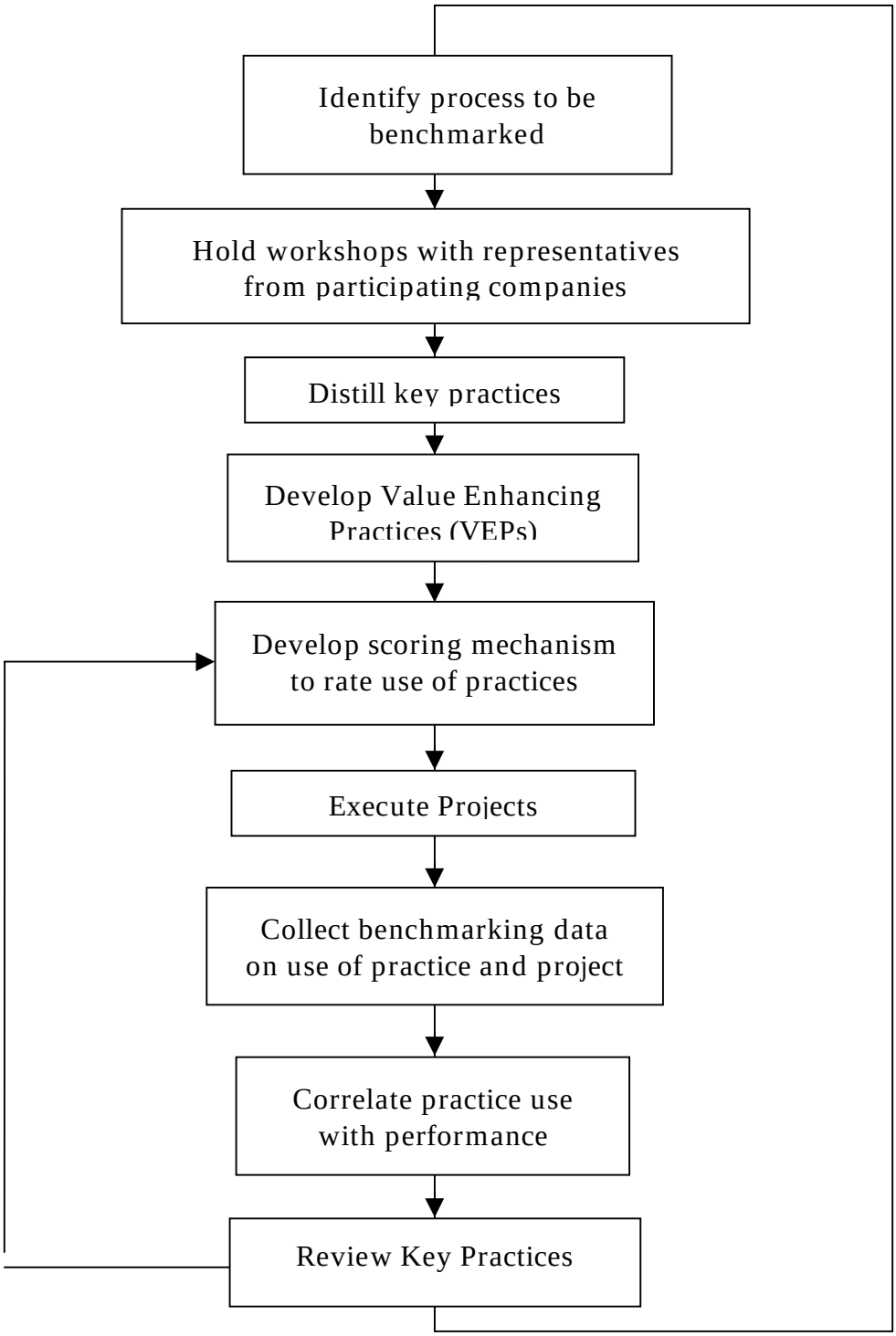
These particular elements of project execution have been addressed by the Benchmarking Steering Committee because they offer the greatest opportunity for performance enhancement on construction projects. The Value Enhancing Practices relating to these elements have been developed by the CII, following rigorous research and knowledge pooling by representatives of leading client and contractor organisations in the USA. The summaries contained in this booklet have been distilled from large volumes of material and they provide the essential core elements of these practices.

The source material is referenced against each of the summaries for those who wish to analyse them in greater depth.

The purpose of the summaries is to facilitate participation in the CII / ECI Benchmarking exercise. However, it is important to emphasise that it is not essential for participation in the benchmarking that subscribers adopt these VEPs, since what is being benchmarked is the companies existing practice against industry medians as determined from a database of over 700 projects. If, however, as a result of benchmarking, companies find their practices to be deficient, those summarised here should provide a basis for improvement.

It is intended that these VEPs will be regularly reviewed to encompass improvements in the practice generated either by research or by the results of the performance benchmarking. The context in which the VEPs are used is shown in the following flowchart, which shows the process for introducing new VEPs, including iterative development of the scoring mechanism to ensure accurate correlation between VEP use and project performance.

The Benchmarking Process



Members of Steering Committee

This document has been compiled by the ECI Benchmarking Steering Committee, based upon the work of the CII. The Committee members involved in compiling the document were:-

Mike Mills	- Brown & Root Energy Services
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Summary of Value Enhancement Practice

Team Building

1 Definition

Team Building is a process that brings together a diverse group of project participants and seeks to resolve differences, remove roadblocks and pro-actively build a focused and motivated work team that strives for a common mission and for shared goals, objectives and priorities.

It is generally intended to describe a formal process on a single project and should be distinguished from partnering which is a broader concept, typically focused on multiple project relationships.

2 Characteristics of Effective Teams

- Trust
- Team members are balanced, taking into account behavioural skills of members.
- Members listen to, co-operate with, support and respect each other
- No hidden agenda
- Candour is the norm
- Problem solving instead of blaming
- Frequent Performance Feedback
- Conflict allowed with emphasis on resolution
- Members are kept informed
- Team understands and is committed to project goals
- Team Charter is in place and followed
- Roles and responsibilities are well defined
- Continuous improvement is a team project goal
- Decisions are based on facts, not personalities

NB The key characteristics are the first six. Trust is the basis for the entire list. Without trust, members are guarded with self-protection, and can certainly be less than candid. With trust, candour can truly be the norm. Candour (the truth, the whole truth and nothing but the truth) is a must for a team to function effectively. Candour allows problem solving to take place and for the 'sticky' issues to surface.

3 Recommendations

To achieve the potential benefits, a Team Building Process must be adopted, using many forms of Team Building, not just a single event and defining the team building actions that will be used regularly throughout the project. The following steps should be included:

a) Select team members:
- Who are suitably qualified and experienced, making best use of strengths and abilities
- Who have a balance of behavioural skills
- Representing relevant stakeholders, e.g. client, contractor, as appropriate.

b) Use an independent consultant to facilitate the team building process:
- Use an in-house or external team building facilitator, who will have the necessary skills to guide the team towards open and trusting communications
- Consider the facilitator becoming the project team building co-ordinator on a regular basis.

c) Hold a team building retreat early in the life of the project:
- All project participants, including project leadership, have team building responsibilities that are common to everyone.
- Identify / communicate project goals and objectives.
- Align individual and team goals / objectives with project goals / objectives.

d) Have a documented team building implementation plan:
- Project Team Charter (providing project information, the responsibility and authority of the team).
- Project Team Code of Conduct.
- Dispute Resolution Process
- Expectation Matrix
- Group Problem Solving Process.

e) Clearly Define and document objectives of the team building process:
- Focus on project
- Unify key stakeholders
- Resolve differences
- Remove roadblocks
- Build trust and commitment.

f) Hold Team Maintenance Meetings throughout the Project:
- Involve many team members in regular reviews with care management.
- Make team building part of the project strategy. Ideally facilitator becomes part of team.
- Recognise / reward individuals and teams who support team concept.

g) Hold follow-up sessions to integrate new team members and reinforce concepts.
- New members to be aligned with team goals when brought on board.

h) Use team building regularly through all project phases:
- Initiate at project conception, ie, before project definition
- Use a co-ordinator.

i) Involve all parties in team building process:
- Broad participation
- All prime contractors, suppliers and major sub-contractors to be educated and integrated into the team as soon as possible.

4 References

Team Building: Improving Project Performance CII Documenet 37 and EM37

Team Building: Implications for the Design/Construction Process CII Document SD87

Team Building: A Process for Project Success CII Conference 1996

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Summary of Value Enhancement Practice

Strategic Alliances

1 Definition

Strategic Alliancing (or Partnering) denotes a co-operative association with one or more non-affiliated organisation, used to achieve specific business objectives by maximising the effectiveness of each participant's resources. The association is based upon mutual trust, the alignment of targets and objectives and the satisfactory performance of each participant, and the alliance as a whole, rather than pure contractual obligations.

2 Characteristics of Partnering/Strategic Alliances

- Partnering can offer a competitive advantage for the construction industry, with effective planning and implementation.

- Strategic Alliancing (or Partnering) arrangements are generally for a period of time rather than for a specific project.

- The key factors in implementing and managing successful partnering relationships are:

    - Establishing trust
    - Top management's support
    - Ownership at working level
    - Establishing Win / Win objectives
    - Addressing internal barriers and promoting co-operation
    - Establishing champion to direct the process
    - Developing measures, linked to objectives

- Continuous monitoring of results, process and relationship measures as these are critical in assessing effectiveness of partnering relationships, and in developing action plans for continual improvement.

3 Recommendations

To achieve the potential benefits, the following steps are recommended:

3.1 Owners Internal Alignment

Partnering is owner driven and needs to be evaluated as a potential business strategy.

- Clear business drivers identified
- Owner core competencies identified
- Partnering concept evaluated
- Clear decision to proceed with partnering
- Owner organisation aligned.

3.2 Select Optimum Partner

- Empowered selection team established
- Selection criteria established
- Screening and selection process established
- Alignment on final selection

3.3 Partnering Relationship Alignment

- Process for building trusting relationship established
- Partnering relationship integrated into strategic plans
- Alliance objectives, measures and reward system agreed
- Partnering organisation design complete
- Open and effective communication process established
- Objective and key services identified
- Staffing plan developed
- Conflict resolution process developed
- Rollout plan developed
- Employee training plan developed and implemented.
- Partnering arrangement co-exists with the contract without modifying the provisions.

3.4 Project Alignment

- Owner's and contractor's success criteria established
- Project objectives established and align with alliance objectives
- Project performance measures established
- Intraproject goals consistent with project objectives
- Objectives and measures clearly communicated
- Consistency of key resources ensured
- Project team empowered
- Appropriate tools and resources provided
- Process for building trust and teamwork established.

3.5 Establish Project Team Work Processes

- Work process evaluated, selected and standardised
- Project staffed for success
- Decision and dispute resolution process established
- Project objectives communicated
- Key resources assigned
- Innovative process established.

3.6 Feedback

- Continuous monitoring and evaluation of both the alliancing / partnership objectives and the participants' business objectives.
- Regular documentation of lessons learned.

4 References

In Search of Partnering Excellence CII Special Publication SP17-1

Model for Partnering Excellence CII Research Report 102-1

Partnering : Meeting the Challenges of the Future CII Special Publication SP6

The Partnering Process – Its Benefits, Implementation and Measurement CII Research Report RR 102-11

Partnering in the Public Sector – A Toolkit ECI-ISBN 1 873844 34 4, 1997

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Summary of Value Enhancement Practice

Pre-Project Planning

1. Definition

Pre-Project Planning involves the process of developing sufficient strategic information to allow stakeholders to evaluate risk and decide whether or not to commit resources to maximise the chance for a successful project. It is often perceived as synonymous with front-end loading, front-end planning, feasibility analysis, and conceptual planning.

2. Characteristics of Successful Pre-Project Planning

- Stakeholders' interests are appropriately represented in the pre-project planning. Stakeholders will include clients, co-venturers and alliance partners as well as key individuals from the various organisation functions, including the executing project manager.
- The Pre–project planning budget and schedule are sufficient to meet the objectives of the pre-planning phase.
- The culture of the team supports collaboration and teamwork
- Team meetings are timely and effective
- The reward and recognition system promotes meeting appropriate project objectives, which are identified before work commences
- Project budget and schedule requirements are well defined
- Scope definition checklists are being effectively used to lead to the most appropriate concept for the project, including issues such as health, safety, environment, constructability, etc.
- Project leadership is defined and effective

- Communication within the team and with outside stakeholders is open and effective

- The relative priorities between cost, schedule and required features for the project are clear

- Uncertainties (opportunities as well as risks) are identified with clear project team member responsibility assigned to manage and / or mitigate each item on the risk register.

Benefits of the above include:

- Improved cost predictability

- Improved schedule predictability

- Reduced probability of budget and / or schedule overruns.

- Better attainment of operational and production goals

- Better achievement of business goals

- Better management of uncertainties

- Fewer scope changes

- Ownership of project concept, planning, budget and goals by executing project team

  In summary, pre-project planning represents a significant opportunity for stakeholders to improve all aspects of project performance.

3. Recommendations

To achieve the potential benefits, the following steps are recommended:

3.1 Organise for Pre-project Planning

- Select and develop team (including team leader) with appropriate skills and expertise

- Use skilled and experienced members who can respond to business and project objectives and provide critical inputs from business, project management / technical and operational interests. The team must also have suitable authority to make project decisions

- Draft charter that compares concept alternatives and arrives at a workable project-based concept

- Prepare plan for pre-project planning, documenting the methods and resources for completing the team's activities

3.2 Select Alternatives for the Project

- Analyse technology; evaluate existing and emerging technologies for feasibility and compatibility with business and operational objectives

- Evaluate sites; evaluate alternative siting locations to meet client needs in terms of relative strengths and weaknesses. Site alternatives could be global, local or even inside an existing building

- Record all key assumptions and decisions including reasons for non-selection of options

3.3 Develop Project Definition Package

- Analyse Project Uncertainties: Uncertainties associated with selected project alternatives are identified and analysed, (to include financial / business, regulatory, project, and operational risks and opportunities) and a management / mitigation plan formulated

- Document Project Scopes and Design: The commercial and technical intent of the project is clearly identified, and the project design is brought to that stage of completion necessary to reasonably define the scope

- Define Project Execution Approach: Address and document the methods to be used to perform the detailed design, procurement, validation, construction, and start-up of the project

- Define contracting strategy that most appropriately accounts for the commercial, technical and political features of the projects

- Establish Project Control Guidelines: Detailed procedures are developed to manage execution of the project, including control guidelines such as milestone CPM schedules, procurement schedules, safety guidelines, validation master plan, and a control plan that addresses such issues as planning, scheduling, change management, and management information systems

- Compile Project Definition Package: Information developed above is compiled into an authorisation package that allows a decision to be made regarding the viability of the overall project. A more detailed project definition package provides the basis for project execution if the project is authorised

4. References

Pre-Project Planning Tools: PDRI and Alignment CII Publications 113-1

Team Alignment During Pre-Project Planning of Capital Facilities CII Research report 113-12

PDRI, Project Definition Rating Index, Industrial Projects CII Implementation Resource 113-2

Project Definition Rating Index (PDRI) CII Research Report 113-11

Pre-Project Planning Handbook CII Special Publication 39-2

Pre-Project Planning: Beginning a Project the Right Way CII Publication 39-1

Perceptions of Representatives Concerning Project Success and Pre-Project Planning Effort CII Source Document 102

Analysis of Pre-Project Planning Effort and Success Variables for Capital Facility Projects CII Source Document 105

Modelling Pre-Project Planning for the Construction of Capital Facilities CII Source Document 94

Uncertainty Management Workshop – ECI Benchmarking Steering Group, October 1998

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Summary of Value Enhancement Practice

Design/Information Technology

1 Definition

The application of information technology to the design and construction process through the use of tools, such as: electronic design and engineering, construction automation, and electronic data exchange and integration.

2 Introduction to Key Technologies

2.1 Integrated Database (IDB)

An integrated database is a means of organising, storing and managing all electronic data relating to a major activity or area of interest, eg, a project, in such a fashion that data is entered and stored once and then accessed and utilised by multiple users and applications. The actual data may reside in one or more locations, operating platforms and formats.

Within the integrated database, data can be accessed, transferred, combined, sorted, manipulated and re-used within defined limitations, controls and data security measures. Successful implementation of the technology could have a positive impact on project performance by facilitating data sharing, eg. between planning, design, procurement, construction, plant operations and suppliers.

Primary benefits include fewer errors, eliminating duplicate effort and input, and shorter cycle times. The objective is to improve the quality of the information processing system by eliminating redundant efforts.

Material management provides a good example of IDB in action, ie,

Engineer – defines specification & quantities.
Material Control – consolidates quantities & produces requisition.
Purchasing –issues enquiries, awards order.
Vendor – provides price and delivery status.
Expediting – updates status from vendor.
Site – acknowledges receipt and authorises payment.
Accounting – processes payment.

2.2 Electronic Data Interchange (EDI)

EDI is a technology that permits direct computer-to-computer exchange of information in a standard format. EDI eliminates the need to re-key data from paper documents into an electronic form. The system requires an in-house application, eg materials management system, software package to translate the information and communications system to transmit and receive the EDI messages. Documents such as purchase orders, material releases, supplier bids, inspection reports are routinely transmitted using EDI.

For the successful operation of EDI, it is essential to:

- Identify types of data up front to fully understand how it is received, delivered, stored, retrieved and managed.

- Determine, at an early stage, the strategy for data handover.

- Agree standards to facilitate interchange with other organisations.

2.3 3D Computed Aided Design (CAD) Modelling

The construction industry has matured to a state where activities in the design, fabrication, construction and operation of facilities can be integrated using computer technology, in particular through the use of 3D CAD systems.

The term, 3D modelling, refers to the use of computer hardware along with analysis / design packages, databases and graphics software for a three-dimensional geometric representation of a facility. Specialists in different disciplines, eg, designers and constructors, can examine and view a 3-D model at various levels of detail. This helps improve communication and reduce barriers between the upstream (design and engineering) and downstream (construction personnel and processes).

Among other things, it has aided owners and engineers in significantly improving constructability and reducing the cost of rework during field erection through the use of interference checking, improved visualisation for planning, and simulation and walk-through investigations before construction. It can be further enhanced by the application of on-site computer systems which communicate with home-office systems.

The following areas of application for 3-D modelling systems have been identified as beneficial:
- Owner records / operations management
- Client / owner design reviews
- Engineer / constructor design reviews
- Configuration change and drawing co-ordination
- Construction sequencing
- Construction simulation / visualisation
- Integration with fabricators
- Customised access to model

- Material management, tracking, scheduling
- Project planning, reporting and control
- Start-up planning
- Safety assessment
- Definition of work packages
- Work breakdown and estimating
- Operation / maintenance training.

2.4 Bar Coding

Whilst it would be difficult to reduce data requirements on projects the costs associated with data handling can be reduced by the use of Bar Code technology. A bar code is simply a self-contained message with information encoded in the widths of the bars and spaces in a printed pattern.

The benefits of bar coding are that data entered is essentially error-free and data consolidation can be greatly facilitated through the use of hand-held portable data terminals.

Suitable applications for bar-coding include:

- Material control
  - receive, inventory, issue, install, inspect
  - bar-coding on major equipment items
  - bar-coded paperwork

- Tool and consumable material control
  - bar codes on tools, employees IDs
  - bar coded menu tablets for common tools

- Purchasing and accounting
  - bar codes supplied to vendors for vendor submittals and paperwork

- Timekeeping
  -bar coded IDs with readers at gates
  - bar coded time forms

- Quantity take-off
  - bar coded menu tablet

- Document control
  - bar coded drawing titles / IDs

- Capital asset management
  - bar codes on installed equipment
  - bar codes on office equipment

3 Recommendations

- A strategy and implementation plan on the use of EDI is considered at the pre-project planning stage.
- Automation and new technologies are used in the design, fabrication, and construction processes.
- Computer-Aided Engineering / Design (CAE / CAD) is used in the design, fabrication and construction processes.
- -An integrated database is used for the design, fabrication, and construction processes.
- Office automation, electronic mail, file transfer, etc. are utilised effectively for efficient home office and field communication and interfaces.
- Data is exchanged directly from computer to computer in a standard format.
- The use of integrated databases and electronic data processing and transfer is a part of the project procedure manual and project execution plan.
- The specific technologies and level of automation to be used are defined in the project procedure manual and project execution plan.
- The functions of scheduling, cost control, estimating, materials management and productivity measurement are automated and integrated in a common database.
- Keep updated on industry trends in software and hardware development.

4 References

3D CAD Link, CII Publication 106-1

3-D Modelling as a Tool to Improve Integrated Design in Construction, CII Source Document 104

Achieving an Integrated Data Environment: A Strategic Initiative, CII Publication 20-3

EDI : Concepts and Applications, CII Publication 20-1

An Introduction to Integrated Database Systems, CII Publication 20-2

Data Integration Strategies in Construction, CII Source Document 57

CAD/CAE In the Construction Industry, CII Publication 8-3

Data Transfer and EDI Volume 1 An Introduction, ECI Publication TF015 / 2.

Data Transfer and EDI Volume 2 EDI and STEP, ECI Publication TF015 / 3.

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Summary of Value Enhancement Practice

Constructability

1 Definition

Constructability is the optimum use of construction knowledge and experience in planning, design, procurement and field operations to achieve overall project objectives. Constructability is achieved through the effective and timely integration of construction input into planning and design as well as field operations.

2 Characteristics of Successful Constructability Programs

2.1 Conceptual Planning Stage

- constructability program is integral part of project execution plan;
- project planning involves construction knowledge, experience and needs;
- early construction involvement is considered as a critical part of the development of contracting strategy;
- project schedules are construction sensitive and must allow for an appropriate strategy to deal with change.;
- basic design approaches consider major construction methods;
- site layouts promote efficient and safe construction;
- project team participants responsible for constructability are identified early;
- advanced information and construction technologies are applied throughout project.

2.2 Design/Procurement Stage

- design and procurement schedules are construction sensitive, including recognition of the logistics impact;
- designs are configured to enable safe and efficient construction;
- design elements are standardised;
- construction efficiency is considered in specification development;
- account is taken of site specific conditions, regulations and requirements, eg, working under “permit” conditions;
- module / pre-assembly designs are prepared to facilitate fabrication, transport and installation;

- designs facilitate construction under adverse weather conditions;
- design and construction sequencing facilitates system commissioning.

2.3 Construction Stage

- innovative and safe construction methods are used where appropriate;
- continuous involvement of all supporting phases are maintained, e.g, procurement.

3 Recommendations

To achieve the potential benefits, good constructability practices should be implemented during the project. The following measures should be considered:

a) Commit to a formal constructability program:
   - assess and recognise constructability benefits;
   - develop implementation policy;
   - identify constructability sponsor / champion;
   - establish functional support organisation and procedures.

b) Use suitably qualified project personnel trained in constructability concepts;
   - project personnel understand constructability objectives, methods, concepts and barriers and also safety;
   - perform self assessment and identify barriers

c) Identify project constructability co-ordinator:
   - has key role in project;
   - establishes constructability team which is identified on a published organisation chart;
   - defines constructability objectives and measures;
   - identifies and conducts specific constructability studies.

d) Produce project constructability manual:
   - written plan for implementation of constructability;
   - contains constructability procedures, integrated into project activities;
   - includes lessons learned file;
   - consider computerised constructability database.

e) Pro-active approach to constructability from pre-project planning stage:
   - incorporate into contracting strategy;
   - use in appointment of contractors, vendors, consultants;
   - identify and address project barriers;
   - ensure use of constructability procedures.

f) Constructability concepts to be consistently considered, evaluated and implemented:
   - invite constructability ideas e.g.: by review meetings, questionnaires, suggestion box;

- incorporate regular constructability reviews;
- routinely consult lessons learned.

g) Project constructability program to be part of corporate constructability program:
   - identify cost savings due to project constructability program;
   - post project, evaluate effectiveness of corporate program;
   - updates lessons learned databases.

4 References

Constructability Implementation Guide, CII Special Publication 34-1

Preview of Constructability Implementation, CII Publication 34-2

Constructability: Program Assessment and Barriers to Implementation, CII Source Document 85

Benefits and Costs of Constructability: Four Case Studies, CII Source Document 83

Project-Level Model and Approaches to Implement Constructability, CII Source Document 82

Constructability Improvement Using Prefabrication, Preassembly, and Modularization, CII Source Document 25

Guidelines for Implementing a Constructability Program, CII Publication 3-2

Constructability Concepts File, CII Publication 3-3

Constructability Improvements During Engineering and Procurement, CII Source Document 5

Constructability Improvements During Conceptual Planning, CII Source Document 4

Constructability: A Primer, CII Publication 3

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Summary of Value Enhancement Practice

Project Change Management

1 Definition

Project Change Management denotes the practices related to the management and control of both scope changes and project changes. Changes are any additions, deletions or other revisions within the general scope of a contract that causes an adjustment to the contract price, contract time, risk or operational performance.

2 Good Practice in Managing Change Effectively

- Encourage all business planning participants to think, act and function as a team.
- Employ responsible personnel who are experienced, knowledgeable and aware of the detrimental effects of unwarranted changes.
- Attempt to maintain continuity of key project personnel.
- Identify the true "clients" for the project and address operability and maintainability and decommissioning / demolition.
- Conceptual engineering personnel should be aware of need to co-ordinate their work with others, both horizontally (interdiscipline) and vertically (across phases).
- Develop construction methods capable of accommodating the type and amount of changes that are reasonably expected to occur.
- Recognise that change can involve much more than a change to project scope, e.g. schedule, involvement of other contractors, weather considerations, changed site conditions, risk.
- Be aware that productivity declines with increased changes within both the engineering and construction phrases.
- Note that minimising change is most effectively achieved by good pre-project planning.

3 Recommendations

a) Formal change management process forms part of project design plan and procedures:
- understood by principal project participants,
- used to actively manage project changes,
- integrate new organisations, throughout asset life.

b) Baseline project scope established early in project:
- ensure adequately defined in order to track deviations from the baseline,
- ensure baseline consistent with project's business objectives; include economic / justification basis,
- if baseline documents based on similar projects, relevant work execution methods to be understood.

c) Establish design freeze:
- ensure design freeze communicated fully,
- distinguish changes from design developments.

d) Identify and evaluate areas susceptible to change:
- identify during review of project design,
- evaluate for opportunities and risk,
- use construction conferences with interrelated project disciplines to deter "surprise" changes,
- avoid glossing over potential pitfalls.

e) Evaluate changes against business drivers and success criteria for project:
- question whether a change is consistent with normal development.

f) All changes to go through formal change justification procedure:
- allow flexibility to investigate possible beneficial changes,
- define level of decision-making authority.

g) Make authorisation for change mandatory <u>before</u> implementation:
- authorisation should be timely and decisive,
- changes that have little or no effect on scope and schedule should <u>not</u> proceed without authorisation.

h) Change information to be communicated to project participants:
- provide adequate notice to affected parties to allow alternatives to the change to be proposed,
- establish tracking methods to avoid delays in communicating change information.

i) Change orders to be promptly agreed, authorised and executed:
- mishandling of changes can result in serious claims or disputes,
- changes that cannot be settled need to be explored for compromises,

- never expect differences to resolve themselves.

j) Project contract to address:
   - criteria for classifying and evaluating change,
   - personnel authorised to request and approve change,
   - basis for adjusting the contract.

k) Establish tolerance level for changes and communicate to project personnel:
   - this tolerance level will vary i.e. at project planning phase, changes can be incorporated at relatively low cost,
   - use control methods that track the accumulation of changes and their overall effect on the project.

l) Process all changes through one owner representative:
   - at outset of project, owner and contractor representatives to establish mechanism for administering change,
   - ensure owner representative informed of risks when a change has been identified.

m) Evaluate changes at project close out:
   - impact on project cost,
   - impact on project schedule,
   - develop a lessons learned database for future projects.

n) Use Work Breakdown Structure (WBS) for control purposes:
   - to provide baseline for adjustments due to changes on a fixed price project, contractor should submit prior to mobilisation:
     - a WBS for project, resource loaded to include planned worker loads per control level element;
     - a Control Schedule in critical path format, consistent with WBS.

4 References

Quantitative Impacts of Project Change, CII Source Document 108

Project Change Management, CII Special Publication 43-1

Quantitative Effects of Project Change, CII Special Publication 43-2

Construction Changes and Change Orders: Their Magnitude and Impact, CII Source Document 66

The Impact of Changes on Construction Cost and Schedule, CII Publication 6-10

Early Warning Signs of Project Changes, CII Source Document 91

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Summary of Value Enhancement Practice

Safety (Zero Accident) Techniques

1 Definition

Safety includes the site specific programme and efforts to create a project environment and state of mind which embraces the concept that all accidents are preventable and that zero accidents is an attainable goal.

2 Key Elements of Safety Approach

- Adopt a “zero injury” philosophy,
- A management initiated culture change may be necessary,
- Establish specific contract safety requirements,
- Recognise quality of effort is more important than time spent,
- Understand the high cost of worker injury.
- Recognise the benefits from considering constructability
- Conduct a safety self-assessment,
- Ensure owner is an active participant,
- Ensure all parties employ relevant competent staff
- Ensure subcontractors are active participants
- Success in eliminating accidents is not guaranteed.

3 Recommendations

To achieve the maximum potential benefit, adherence to a recognised formal safety management system is essential. Furthermore, a safety process must follow relevant statutory regulations and should comply with the following structure.

3.1 Each project has a written site-specific safety plan, to include, as a minimum:

- Management safety policy statement,
- Safety goals and objectives and methods of measuring effectiveness,
- Outline of responsibilities for managers, supervisors, safety representatives and craft workers,

- Procedures for safety activities.
- Defined safety structure
- Defined competency requirements for staff at appropriate levels
- Specific measures for dealing with areas of significant risk

3.2 Each project has a written site-specific emergency plan.
- Should identify the different types of foreseeable emergencies,
- Should specify procedures to follow in case of an emergency and responsibilities for action

3.3 Each project has a nominated site safety supervisor who's experience is commensurate with the size of the project
- To be available full-time
- Ensures regular safety inspections and audits.
- Ensures accurate record keeping.
- Has ready access to site manager

3.4 A written safety incentive programme is in place for hourly paid craft employees, based upon positive actions, (ie not upon zero accidents):
- Can be in form of informal recognition or formal, eg, lunches, monetary award.
- Make part of evaluation process for bonuses.

3.5 Toolbox Safety meetings are held
- Attendance to be mandatory.
- Project manager, superintendent and / or safety representative should regularly attend to show support for safety.
- These should be focussed and not overlong

3.6 Companies to have a policy for substance abuse which should make the following points:
- All staff should be aware of it
- It offers a supportive approach, viewing such problems as medical
- It provides health education on the dangers of excessive alcohol consumption and drug abuse
- Employees are encouraged to seek help before a problem arises at work. However, where performance, attendance or behaviour are unsatisfactory, the supervisor seeks a medical report
- If the report indicates alcohol or drugs as the cause, the disciplinary / capability procedure is postponed whilst treatment is undertaken
- If treatment is declined, or there is a relapse or the medical report does not point to an alcohol or drug problem, the disciplinary / capability procedure (which could lead to dismissal) is reinstated

3.7 Accidents are always formally investigated by a competent person:
- Corrective action to be taken as soon as possible after investigation is complete,
- Reports of investigation distributed and communicated to all employees to avoid re-occurrence.

3.8 Near misses are always formally investigated by a competent person to a depth commensurate with potential outcome:
- Corrective action to be taken as soon as possible.
- all employees regularly advised of near-misses to avoid re-occurrence.
- employees are made aware of the benefits of reporting

NB Making zero near-misses an objective may result in them not being reported and so defeat objective.

3.9 Accidents are reviewed by senior management:
- Basic causes of accidents need to be determined,
- Information to be shared with other job sites,
- Ensures follow-up action taken.

3.10 Safety is a high priority topic at all pre-construction and construction meetings
- Enforcement procedures for safety rules should be applied equally among all project personnel.
- Recognise at the pre-construction phase the safety benefits from carrying out a constructability review.

3.11 Safety records and validated competencies are a criterion for contractor/sub-contractor selection
- Records are required for both control and audit purposes; they should also be seen as important data which will be considered in contractor selection.

3.12 Pre-task planning for safety is carried out by contractor foremen
- Use checklists to ensure all exposures considered,
- Necessary equipment training provided,
- Appropriate protective equipment provided.
- Who have been trained for such a task
- Evidence of such is available for inspection

3.13 Job site – specific orientation is conducted for new contractor and subcontractor employees, to address as a minimum:
- Clarification of safety responsibilities for contractor, subcontractor employees and all construction site personnel, including visitors,
- Safety expectations of the employees,
- Explanation of company safety rules,
- Location of first-aid facilities and how to be utilised,
- Procedures for reporting accidents and injuries,
- Information on tool-box meetings,
- Use of personal protective equipment,
- Procedures for reporting unsafe acts or conditions.

3.14 Regular formal safety audits to be undertaken following a recognised process. Results to be quickly fed back into project team and any recommendations / observations to be quickly implemented.

4 References

Addressing Construction Worker Safety in the Project Design, CII Research Report 101-11.

Zero Injury Techniques, CII Research Summary 32-1

Zero Injury Economics, CII Implementation Resource 32-2

Zero Accident Techniques, CII Research Report 86

Construction Safety Self-Assessment Process, CII Research Report 88

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Subcontractor Safety as Influenced by General Contractors on Small- and Medium-Sized Projects, CII Research Report 38

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