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ASSESSMENT OF CII BEST PRACTICES IMPLEMENTATION AT THE ORGANIZATIONAL LEVEL

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ABSTRACT
The construction industry has become more competitive and organizations need to be continuously improved in order to remain successful. One way of improving organizations is implementing knowledge or existing research products typically developed by various universities and research institutes such as the Construction Industry Institute (CII). Although there are many valuable research products available which have tremendous potential to improve construction project performance as well as the organization's business processes, many of them have not been implemented to a significant extent on real world projects. Despite the importance of the implementation effort, there is little research focused on the implementation of existing research products or measuring the degree of the implementation effort. CII has identified the importance of implementation and constituted the Implementation Strategy Committee (ISC) which concentrates on the implementation of CII knowledge. The traditional philosophy of construction management places great emphasis on the ability to plan and execute individual projects. In contrast, a similar emphasis on the overall ability of an organization is many times lacking in the construction industry. This paper will focus on assessing a construction organization's implementation effort at the organizational level using construction-related knowledge that CII has developed. A survey questionnaire was developed based on the information gathered from literature and inputs from industry participants to evaluate the organizational implementation status. A pilot survey was conducted for the validation purpose and the finalized questionnaire has been distributed to 88 CII member companies including both owner and contractor organizations. This paper will describe the research process that has been followed as well as findings and recommendations of the study. Differences between owners of facilities and contractor firms will be highlighted and policy implication will be presented.

KEYWORDS
Research Implementation, Knowledge Management, CII Best Practices, Organizational Assessment

1. INTRODUCTION

The construction industry has become more competitive and organizations need to be continuously improved in order to remain successful. One way of improving organizations is implementing knowledge or new practices which can be obtained from research products typically developed by various universities and research institutes such as the Construction Industry Institute (CII). Demarest (1997) has indicated that effective knowledge management which includes properly implementing knowledge is the key to competition in order for organizations to survive. Although there are many valuable research products available which have tremendous potential to

improve construction project performance as well as the organization's business processes, many of them have not been implemented to a significant extent on real world projects (Smith, 1995).

Although the importance of implementation is widely recognized, there is little research done focused on implementing research products or measuring the implementation effort. CII has conducted some researches to increase the level of implementation of CII products and has also tried to measure the degree of implementation of some of its products as well as project performance, but they have been concentrated on the project level and not on the organizational level. The traditional philosophy of construction management also places great emphasis on the ability to plan and execute individual projects (Chinowsky, 2000). In contrast, a similar emphasis on the overall ability of an organization is many times lacking in the construction industry although it usually influences on individual project performance to a great extent. This paper will focus on assessing a construction organization's implementation effort at the organizational level using construction-related knowledge that CII has developed.

1.1 Construction Industry Institute (CII)

CII which sponsored this study is a research organization formed in 1983 with a mission of improving the competitiveness of the construction industry (CII, 2001). As a unique consortium of owners, contractors, and academia, CII has produced many research products since its initiation to help its member companies to find better ways of planning and executing capital facility projects. In spite of the tremendous potentials of many of its findings, implementation of CII products by the industry has been somewhat disappointing. Implementation barriers do exist, and CII has worked to identify barriers that inhibit innovation and change and contribute to slow industry progress (CII, 1995). Identified barriers to implementation include:

- low familiarity with best practices
- lack of commitment to best practices
- limited emphasis on training and education of best practices
- failure to integrate new ideas and recommendations into company procedures
- limited benchmarking of costs and benefits
- lack of innovation within the industry due to risk aversion

CII has also addressed implementation as being one of six distinctive core competencies in its strategic plan (CII, 2001). In order to facilitate effective implementation of CII products and overcome implementation barriers, the CII Implementation Strategy Committee (ISC) was formed as a standing committee in late 1995 to address this core value. 'CII Implementation Model' was developed by the ISC to assist organizations wishing to implement CII products as one of its initial efforts to improve implementation. The CII Implementation Model contains a foundation and nine recommendations for an organization to pursue in implementing best practices. The CII ISC also sponsored the study to develop the CII Knowledge Structure to organize its products and to help increase implementation. The CII Knowledge Structure is defined as the overall body of CII knowledge arranged in topological form (Kim and Gibson, 2001). It provides an easy mechanism for finding and using CII products. Both the CII Implementation Model and the CII Knowledge Structure served as basis for developing the survey instrument used in this study to measure the implementation status of an organization.

1.2 CII Implementation Model

To help member companies effectively implement CII products, including best practices, the CII ISC has developed an Implementation Model that specifies the steps of implementing a CII product as well as foundations. These steps follow the traditional plan-do-check-act continuous improvement model. The CII Implementation Model is illustrated in Figure 1. It is recommended that CII member organizations use the model to craft their implementation efforts (Kim and Gibson, 2001). The structure of the model was utilized in developing the survey questionnaire to evaluate the organizational implementation effort.

Figure 1: CII Implementation Model

1.3 CII Knowledge Structure

In early 1998, the CII ISC identified the need to categorize CII studies and products in order to facilitate understanding and the selection of individual practices for implementation. A sub-committee of the CII ISC was formed with representation from the industry, academia and all the CII standing committees to develop a logical structure and the CII Knowledge Structure was born through a series of meetings in 1998 and 1999. Core terminology was defined concurrently with completion of the CII Knowledge Structure development as well as the Best Practice Screening Process.

The structure consists of Knowledge Areas at the highest level and each Knowledge Area contains several Focus Areas which are further broken into one of the three sub categories based on the Best Practice Screening Process as described in Figure 2. All the CII products including research documents and education materials, then, categorized under a related focus area. The base structure of the CII Knowledge Structure was given in Figure 3. As of December 2001, the CII Knowledge Structure had 13 Knowledge Areas which were broken into 47 Focus Areas including 11 CII Best Practices, 13 CII Proposed Best Practices – Pending Validation, and 24 Information Areas. The list of 11 Best Practices defined in the Knowledge Structure was used in developing the survey to measure the Best Practice implementation at the organizational level. The CII Best Practices are listed in Table 1 with brief process descriptions. Details on the CII Implementation Model and the CII Knowledge Structure are available in CII Implementation Resource 166-2 (2001).

Table 1: CII Best Practices (Kim, 2002)

CII Best Practice	Process Description
Pre-Project Planning	Pre-Project Planning is the process of developing sufficient strategic information with which owners can address risk and decide to commit resources to maximize the chance for a successful project. Pre-project planning is also known as front end loading, front end panning, feasibility analysis, programming, and contractor planning.
Alignment	Alignment is the condition where appropriate project participants are working within acceptable tolerances to develop and meet a uniformly defined and understood set of project objectives.
Constructability	Constructability is the effective and timely integration of construction knowledge input into the conceptual planning, design, construction and field operations of a project to achieve the overall project objectives in the best possible time and accuracy at the most cost effective levels.
Design Effectiveness	Design effectiveness is an all-encompassing term to measure the results of the design effort, including input variables and design execution against the specified expectations of the owner. In addition, the owner's expectations include such criteria as cost, schedule, quality, and other expectations either explicit or implicit in the project objectives.
Material Management	Materials management is an integrated process for planning and controlling all necessary efforts to make certain that the quality and quantity of materials and equipment are appropriately specified in a timely manner, are obtained at a reasonable cost, and are available when needed. The materials management systems combine and integrate the takeoff, vendor evaluation, purchasing, expediting, warehousing, distribution, and disposing of materials functionsl.
Team Building	Team Building is a project-focused process that builds and develops shared goals, interdependence, trust and commitment, and accountability among team members and that seeks to improve team members problem-solving skills.

Partnering	Partnering is a long-term commitment between two or more organizations for the purpose of achieving specific business objectives by maximizing the effectiveness of each participant's resources. This requires changing traditional relationships to a shared culture without regard to organizational boundaries. The relationship is based on trust, dedication to common goals and the understanding of each other's individual expectations and values.
Quality Management	Quality Management incorporates all activities conducted to improve the efficiency, contract compliance and cost effectiveness of design, engineering, procurement, QA/QC, construction, and start-up elements of construction projects.
Change Management	Change Management is the process of incorporating a culture of acceptance and problem solution in an organization to effectively manage project changes.
Dispute Resolution	Dispute resolution techniques include the use of Disputes Review Boards, arbitration, mediation, standing neutral, etc as alternative dispute resolution processes to eliminate the necessity to take disputes to litigation. These techniques provide processes for addressing disputes in their early stages before the dispute affects the progress of the work, creates adversarial positions and lead to litigation.
Zero Accident Techniques	Zero accident techniques include the site specific safety programs and implementation, auditing and incentive efforts to create a project environment and a level of training which embraces the mind set that all accidents are preventable and that zero accidents is an obtainable goal

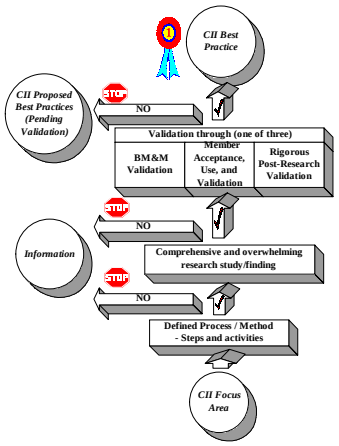

Figure 2: CII Best Practice Screening Process

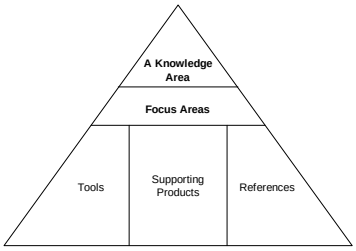

Figure 3: Base Structure of CII Knowledge Structure

1.4 Research Objectives

The primary objective of this study is to quantify the degree of organizational implementation process and to measure CII Best Practices Implementation at the organizational level. Subsidiary objectives to achieve the primary objective are as follows.

- Development and refinement of the CII Knowledge Structure
- Development of a survey questionnaire to measure the organizational implementation process and Best Practices implementation
- Development of CII Knowledge Implementation Index (CKII)
- Investigation of differences between owners and contractors in organizational implementation efforts and CII Best Practices implementation

2. RESEARCH METHODOLOGY

In this section, the research methodology that was followed to conduct this study will be described. Each sub-section will briefly explain involved steps.

2.1 Background Research

This study was initiated by collecting background information related to research implementation. During the background research period, related literature including previous CII researches focused on implementation was reviewed. The CII Implementation Model was intensively reviewed and the CII Knowledge Structure was also developed during this phase of the study. Based on the findings from background research and inputs from the CII ISC, a survey questionnaire was developed to measure the organizational implementation process and Best Practice Implementation. (Kim, 2002)

2.2 Survey Questionnaire Development and Validation

A survey questionnaire was developed based on the findings from background research including the CII Implementation Model and the CII Knowledge Structure. The survey consisted of two parts. Part one was composed of eight sections with 78 questions using Likert scales and each section corresponded to first eight implementation steps that are defined in the CII Implementation Model (Figure 1). This part measured the overall implementation efforts at the organizational level. Survey part two measured the number of CII Best Practices implemented within an organization as well as the degree of their organizational implementation. There were 165 questions in part two within 11 different sections corresponding to the 11 Best Practices that are defined in the CII Knowledge Structure. Most questions had one-to-five answer scales while others were yes/no questions. Participants also had a choice of not answering the question by selecting a 'Not Applicable' option.

Once the survey was developed, a pilot test was conducted with three volunteer organizations. The survey was also reviewed by graduate students at the University of Texas at Austin. After collecting feedback from pilot study participants, the survey was modified and finalized. The finalized survey was deployed on the web to facilitate data collection process using Microsoft™ Active Server Page. After the web deployment, another pilot test was conducted with 4 volunteers and a graduate student at the University of Texas at Austin. The survey was slightly modified as the results of the second pilot test and usability of the survey website was enhanced.

2.3 Survey Distribution

Survey questionnaires were distributed to 88 CII member companies including 45 owners and 43 contractors in September 2001. Each participant received a pre-email notification as a effort to increase the response rate. A hardcopy package was delivered to each organization via postal mail and an email message was also sent with the survey website access information and an attachment of an electronic copy of the survey. Participants had three different ways of completing the survey including the survey web site, email and using the hardcopy.

2.4 Data Collection and Analysis

The data collection process lasted for a little more than two months. During this process, two reminder emails were sent to gather more responses. The data collected from the survey website was automatically stored in a Microsoft™ Access database and the other data received via email and postal mail was entered manually into the database. Only one database was used throughout the data collection process which enhanced the data management process. The database consists of 52 tables and 53 queries and contains several forms. Collected data was analyzed using several software packages including Microsoft™ Access, Microsoft™ Excel, and SPSS® version 11.

3. ANALYSIS RESULTS

3.1 Response Rate

Out of 88 organizations that received a survey questionnaire, 41 organizations participated with the response rate of 46.6%. Most participants, 34 out of 41, used the survey website to complete their surveys while only 4 returned the surveys via postal mail or fax. The remaining three respondents submitted theirs via email.

Response rate from owners was slightly higher than that from contractors. Among 45 owner organizations that were contacted, 22 organizations responded as 19 from 43 contractors completed their surveys. Response rates and the number of surveys received are summarized in Table 2.

Table 2: Survey Response Rates

	Sent	Received	Response Rate
Owners	45	22	48.9 %
Contractors	43	19	44.2 %
Total	88	41	46.6 %

3.2 CII Knowledge Implementation Index (CKII)

A CKII for each participant was calculated from the part one survey data they submitted. The CKII was calculated by adding up the score of 78 questions in part one. In calculating the total, not applicable questions were excluded. Since the number of not applicable questions for each completed questionnaire was different from each other, most questionnaires had different possible maximum scores. In addition, since the answer scale for each question was one-to-five and not starting from zero, minimum scores also varied. In order to make it possible to compare one total with another, all totals were normalized with the minimum score of zero and the maximum score of 200. These normalized CKII scores quantify the implementation status at the organizational level. Summary statistics of 41 CKII scores are provided in Table 3 and the histogram shown in Figure 4 illustrates the CKII distribution among 41 participants. A normality test was also conducted as shown in Table 4, and CKII were normally distributed (Sig. > 0.05).

Table 3: Summary Statistics of CKII

Summary Statistic	Mean	Median	Mode	Standard Deviation	Skewness	Range	Minimum	Maximum
Value	114	109	149	26.09	0.073	111	56	167

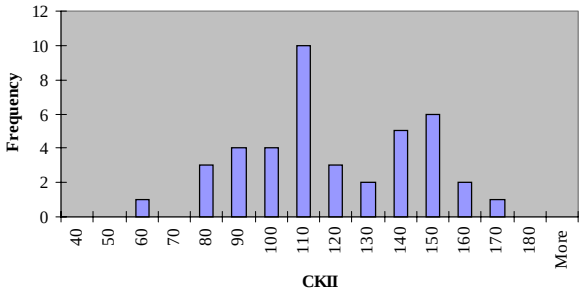

Figure 4: Histogram of CKII Scores

Table 4: Test of Normality - CKII

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
CKII	.109	41	.200*	.979	41	.641

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

As shown in Table 3, the mean of the CKII is 109, which is slightly less than 55% of the maximum score of 200. It indicates that there is room for improvement in terms of the organizational implementation process as compared to the CII Implementation Model. Data also shows that there are wide variances between participating organizations in implementing CII products at the organizational level.

Differences between owners and contractors

An independent t test was used to test the differences between owners and contractors in CKII since the independent t test is for assessing hypotheses involving differences between two means of two independent groups. Three underlying assumptions are also checked to obtain a fairly accurate test result. The evaluated null hypothesis is that there is no difference in CKII between owners and contractors. The test was conducted using SPSS® version 11 and the output is available in Table 5. As shown in Table 5, the p value is greater than 0.05. The difference in means of CKII between owners and contractors are not statistically significant.

Table 5: Independent t Test in CKII between Owners and Contractors

		t test for Equality of Means			
		t	df	Sig. (2-tailed)	Mean diffence
CKII (0-200)	Equal Variances Assumed	-.984	39	.331	-8.04
	Equal Variances not Assumed	-.997	38.960	.325	-8.04

3.3 Analysis of Implementation Steps

As previously mentioned, the first part of the survey consists eight sections that are corresponding eight implementation steps defined in the CII Implementation Model. Each section contains a set of questions that need to be addressed to successfully complete each implementation step. Average scores of each section are shown in Table 6. An analysis of variance (ANOVA) test was conducted to investigate differences among these implementation steps. From the ANOVA test results, 'Self Audit' and 'Measurement' were identified as areas where participating organizations have weaknesses in general compared to other implementation steps.

Table 6: Average Scores of Implementation Steps (sample size = 41)[2]

Implementation Step	Corporate Commitment	Self-Audit	Product Champions/ Review Boards	Product Implementation	Corporate Implementation Champion	Implementation Plans and Goals	Product Training	Measure Results
Mean[1]	3.48	2.63	3.20	3.28	3.48	3.28	3.34	3.02

[1] Maximum mean is 5.
[2] Mean differences between groups are statistically significant (p value from the ANOVA test <0.01)

3.4 Best Practices Implementation

Participating organizations are implementing an average of 5.5 CII Best Practices out of 11 defined in the CII Knowledge Structure. Among 11 CII Best Practices, pre-project planning was the most widely used by participants, while dispute resolution was the least utilized. In addition, there were some differences between owners and contractors in CII Best Practices implementation. Design effectiveness was mostly implemented by owners, while material management and dispute resolution was predominantly used by contractors. Figure 5 shows the distribution of the number of organizations that are implementing specific CII Best Practices.

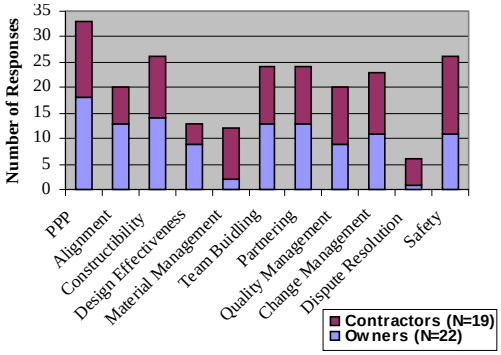

Figure 5: CII Best Practices Implementation

4. CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

Data collected using the survey questionnaire to evaluate the implementation process and CII Best Practices implementation shows that the level of implementation efforts at the organizational level varies widly among participated organizations. It also indicates that there are areas that organizations need to improve in order to implement CII Best Practices more effectively and to get the most out of implementation. Among the eight implementation steps that are specified in the CII Implementation Model, the 'Self-Audit' and 'Measurement' steps were identified as weaker areas compared to other steps, while the participants have higher scores in the areas of 'Corporate Commitment' and 'Corporate Implementation Champion', in general. It is envisioned that the participants will focus on their weak areas first to improve their overall implementation efforts as they continuously try to improve the other steps.

Even though it turned out that the difference between owners and contractors is not significant in terms of their overall implementation status, some differences were identified in types of CII Best Practices that they are implementing (Figure 6). Considering the fact that the potentials of these Best Practices are proven by the CII Best Practice screening process (Figure 2), organizations should try to implement more Best Practices as they are applicable to their business processes. The results from the survey, part two, show that participating organizations implement only an average of 5.5 Best Practices among 11 available, which also shows room for improvement in CII Best Practices implementation.

4.2 Recommendations for Future Research

The survey instrument used in this study certainly provides a way of quantifying the degree of implementation efforts at the organizational level and also a means of benchmarking implementation status compared to competitors in the industry. However, the impact of the implementation process on organizational success has not been evaluated. Even though it is hard to measure the exact impact of the implementation efforts on the organizational success due to various other factors that possibly have influences on it, it would be interesting to see how implementation affects the success of an organization. One possible way of measuring its impact is to collect project performance data from the organizations that participated in this study and compare them with their implementation indices obtained from this study, which is currently underway. By measuring its impacts, the implementation index can also be further validated.

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